AUTISM SPECTRUM DISORDERS:

THE INTERACTION OF SYMPTOMS AND EXECUTIVE SKILLS

A Dissertation

by

ROBB NELSON MATTHEWS

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

December 2011

Major Subject: School Psychology

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ABSTRACT

Autism Spectrum Disorders: The Interaction of Symptoms and Executive Skills.

(December 2011)

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Autism Spectrum Disorders (ASDs) are one form of neurodevelopmental disruption that negatively impacts the integration of perceptual, affective and neuroregulatory mechanisms of typical development. Individuals with ASDs categorically demonstrate difficulties with organizing their thoughts/emotions/actions and applying them in a goal directed manner. The neurobiological deficits underlying cognitive and behavioral disorganization are termed executive functioning (EF) skills deficits. This study sought to clarify the association between the defining characteristics of ASDs and their expression in general behavior and EF skills, using parent and teacher ratings. Results of this study indicated that the association between the Behavior Assessment System for Children, Second Edition (BASC-2) and the symptoms of ASDs as measured by the Autism Spectrum Rating Scale (ASRS) varied by rater, with few clinical scales explaining significant variance in the ASRS outcomes. Additionally, the strongest relationship between the BASC-2 Developmental Social Disorders content scale (DSDCS) and the ASRS Scales was in behavior regulation rather than the social domain. Using the ASRS Scales as predictors of executive skills issues was generally stronger for teachers than parents. Only difficulties on the Self-Regulation Scale were consistently predictive of difficulties with Metacognition Index

(MI) across parent and teacher ratings. The results give direction with regard to identifying behavioral and ecologically relevant cognitive skills and their relationship characteristics of ASDs.

DEDICATION

This document is dedicated to my wife Wendy, an unfailing partner on life's journey.

ACKNOWLEDGEMENTS

Many people have impacted me along this journey toward my doctorate, and although I cannot name them all, I would like to acknowledge a few. My children gave up many aspects of their lives to allow me to pursue this goal. They may not understand how important their sacrifices were to my success, but I am forever grateful to them.

I would like to thank the program faculty for stretching and molding me into the professional I am today and will become tomorrow. Particular thanks to Bill Rae. Without his willingness to be my temporary adviser, I would not have had the opportunity to study at Texas A&M. Special thanks to Anita McCormick for her thoughtful support during my time in the program.

I am hugely indebted to my major professor, Cyndi Riccio. Her insight, guidance, and generosity have been the foundation for my reaching this goal and moving beyond it. Finally, I owe a great deal of thanks to my dissertation committee. Their willingness to take on this project is a testimony to the dedication they maintain toward their students and academia.

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CHAPTER I

INTRODUCTION

Autism Spectrum Disorders

Typical development integrates multiple mechanisms to allow interaction with one's environment and the people therein (Goldstein, 2009). Individuals generally develop along an expected progression from complete dependence on others, toward independence in meeting their needs and the expectations of their environment. Pervasive Developmental Disorders (PDDs), or Autism Spectrum Disorders (ASDs), represent specific neurodevelopmental disruptions in this progression resulting in significant variability (i.e., along a spectrum) among individuals (Baron-Cohen & Belmonte, 2009; Chan et al., 2009; Goldstein, 2009; Greene, Braet, Johnson, & Bellgrove, 2008; O'Hearn, Asato, Ordaz, & Luna, 2008; Pellicano, 2007; Russo et al., 2007; Volker & Lopata, 2008). By definition, individuals with ASDs demonstrate severe and pervasive developmental disruption in reciprocal social interaction accompanied by qualitative communication impairment(s) and/or stereotyped and restricted repetitive patterns of interest and activities (American Psychiatric Association [APA], 2000). The atypical behaviors defining ASDs are markedly different relative to age or developmental expectations for the individual under consideration. The subtypes and behaviors and characteristics of those with ASDs vary significantly in etiology, and subsequently in presentation and complexity (Geschwind, 2009; Goldstein, 2009; Greene et al., 2008; Pellicano, 2007; Volker et al., 2010).

The heterogeneity in presentation may be associated with etiology, course,

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This dissertation follows the style of *Journal of Autism and Developmental Disorders*.

previous intervention, and/or co-occurring conditions in children with ASDs. This diversity of contributing factors can make differentiation between subtypes, as well as other disorders, difficult (Ben-Sasson et al., 2008; Geurts, Corbett, & Solomon, 2009; Mahan & Matson, 2011; Matson, LoVullo, Rivet, & Boisjoli, 2009). Severity can range from mild to moderate symptomatology, where many aspects of typical functioning for developmental age may be present, to severely impaired intellect and behavior. Social impairments can range from difficulties with social cognition (e.g., understanding and responding to interaction) to a lacking need for social interaction. Comparable variations are noted in language development, ranging from individuals with largely typical development, to nonverbal and nonresponsive individuals. Finally, varying degrees of restricted, repetitive stereotypic patterns of behavior, interests or activities (RRBIs) can be manifested in difficulties with shifting set (based on instruction or expectations) to hand flapping and/or tantrumming in the face of even minor environmental change. These non-socially related behaviors are the least researched and understood component of ASDs (Hill, 2004; Lopez, Lincoln, Ozonoff, & Lai, 2005).

Many models and hypotheses have been generated to explain ASDs. Cognitive models have implicated a number of causal or contributory factors, including Executive Functioning (EF) deficits, lacking theory of mind, and inadequate central coherence. Of these, the current study will focus on EF. In addition to these models, a more inclusive behavioral/cognitive approach is gaining increasing acceptance in an effort to better understand ASDs (Happe' & Ronald, 2008; Pellicano, 2007). Summary indicators of behaviors (i.e., individual differences) in particular categories (e.g., social development) have been proposed as one method that may improve the reliability of diagnosis (Joseph & Tager-Flusberg, 2004; Mandy & Skuse, 2008). EF skills deficits have been established as a common problem among neurodevelopmental and acquired neurological disorders, including ASDs. Neither EF skills deficits nor other behaviors that are not part of the diagnostic criteria can be used for diagnostic purposes. Further, the way in which ASD symptomatology maps onto omnibus rating scales or measures of EF has not been established. In particular, many recognize that individuals with ASDs often evidence functional EF skill difficulties (e.g., Ozonoff & Schetter, 2007); however, research to this point has not successfully associated EF deficits and behavioral phenotypes in those with ASDs. This may be due to the way in which EF is measured (i.e., with traditional laboratory measures). The purpose of this study is an initial attempt to address these gaps in the existing knowledge base with relation to how syndrome specific behaviors related to ASDs map onto both ecological EF skills as well as general behavior presentations.

CHAPTER II

LITERATURE REVIEW

Theoretical Models

Ostensibly as diverse as the individuals with ASDs is the number of proposed causal or contributory models, across disciplines and interested parties, within ASD research. Models implicating various cognitive and behavioral factors are prevalent throughout the literature (Happe' & Ronald, 2008). These models purport wide-reaching explanations of the syndrome and its accompanying difficulties (Pellicano, 2010; Rommelse et al., 2011). Cognitive models have implicated a number of causal or contributory factors, including Executive Functioning (EF) deficits, lacking theory of mind, and inadequate central coherence. Neurobiological models have investigated potential genetic risk factors, chromosomal abnormalities, and structural brain differences as causally related to ASDs.

Executive functioning (EF) is a neuropsychological concept broadly used to describe the coordination of multidimensional brain-based systems, which result in higher-level cognitive skills (e.g., attention maintenance, mental flexibility, shifting) and are the precursors to diffuse adaptive behavioral patterns (Bishop & Norsbury, 2005; Burgess et al., 2006; Chan et al., 2009; Greene et al., 2008; Jurado & Rosselli, 2007; Kenworthy, Black, Harrison, Rosa, & Wallace, 2009; Lopez et al., 2005; Pellicano, 2010; Robinson, Goddard, Dritschel, Wisley, & Howlin, 2009; Verte', Geurts, Roeyers, Oosterlaan, & Sergeant, 2006). EF skills of varying complexities allow individuals to organize their thoughts/emotions/actions and apply them in a goal directed manner, which gives EF skills an essential role in daily activities (Hughes & Ensor, 2010; Joseph

& Tager-Flusberg, 2004; Zingerevich & LaVesser, 2009). EF dysfunction can result in a cascade effect causing numerous adverse developmental deviations throughout the lifespan (Goldstein, 2009; Greene et al., 2008; Hughes & Ensor, 2010; Meltzer, 2007). EF related causal theories of ASDs, however, have been plagued by lacking relationships to social and communication deficits, varying outcomes based on measures administered, and a failure to account the presence of similar skills deficits in other neurodevelopmental disorders (e.g., learning disabilities) not evidencing similar behavior patterns to children with ASDs; thus, they cannot stand as a comprehensive causal model of ASDs (Baron-Cohen & Belmonte, 2009; Happe' & Ronald, 2008); Conversely, the potential positive impact of EF skills as well as the negative impact of EF deficits, on the functioning of individuals with ASDs, continues to be a topic of discussion and research (Hughes & Ensor, 2010).

Theory of mind (TOM), or the ability to understand and show empathy for another person's mental state(s), is another cognitive area theorized to explain the behavioral differences widely seen in individuals with an ASDs (Pellicano, Maybery, Durkin, & Maley, 2006). Deficits in TOM have been termed "mindblindness" and have been proposed to account for many of the social, and communication difficulties characteristic of ASDs (Baron-Cohen & Belmonte, 2009). Unfortunately, the TOM theory has been unable to successfully explain the range of RRBIs across ASDs, although some researchers have accounted for their presence solely as confusion or anxiety resulting from social difficulties (Happe' & Ronald, 2008). Weak central coherence (CC), a style of processing information where details are processed individually without relating them to previous learning, was originally proposed as a core deficit in ASDs (Happe´ & Frith, 2006). The precept of individuals with ASDs performing better on tasks requiring local processing and struggling on tasks requiring consideration of context has not been widely supported through research, which raises questions about potential underlying cognitive mechanisms of CC (Joseph & Tager-Flusberg, 2004; Pellicano et al., 2006). Weak CC as a model has also not been useful in explaining the social and communication deficits in ASDs (Happe' & Ronald, 2008).

Neurobiological models have implicated numerous combinations of genetic and chromosomal differences. Chromosomal commonalities have been identified in many combinations, and particular genetic regions have been identified based on the characteristic under consideration (e.g., language, rigidity) rather than the diagnostic criteria (Szatsmari, 1999, Yang and Gill, 2007). In their review of the data, Happe' and Ronald (2008) found no biological cause accounting for more than one to two percent variation in the incidence of ASDs, attributing this finding to the likely complex interaction of biological and environmental factors.

Unfortunately, a singular parsimonious model of neurobiological causal factors underlying ASDs remains unformulated and unlikely, given the myriad of potential symptom patterns and complexities defining the syndrome (Happe' & Ronald, 2008; O'Hearn et al., 2008; Pellicano, 2007). Therefore, ASDs continue to be behaviorally rather than biologically defined in professional and lay communities alike (Baron-Cohen & Belmonte, 2009; Geschwind, 2009; Hill, 2004). At the same time, a more inclusive behavioral/cognitive approach is gaining increasing acceptance in the literature, where the presentation or functionality of individuals with ASDs is integrated like pieces of an extremely detailed puzzle, in an effort to clarify this heterogeneous syndrome (Happe' & Ronald, 2008; Pellicano, 2007). Along this line, summary indicators of behaviors (i.e., individual differences) in particular categories (e.g., social communication, RRBI) has been proposed as a method to increase sophistication and the reliability of identification at differing levels of impact, as well as to allow for comparison of presentation based on combinations of these summary indicators (Joseph & Tager-Flusberg, 2004; Mandy & Skuse, 2008).

EF Skills

Several commonalities underlying the behavioral tenets of ASDs have been noted, suggesting degrees of similarity based on presentation rather than subtype (Hill & Bird, 2006; Mandy & Skuse, 2008). Specifically, EF skills deficits in ASDs have been an increasingly frequent topic of investigation for more than two decades, as many researchers have suggested these deficits either underlie or contribute to many ASD-related behavioral complexities (Geurts et al., 2009; Greene et al., 2008; Hill, 2008; Hill & Bird, 2006; Hughes & Russell, 1993; Robinson et al., 2009; Russell & Jarrold, 1999). Further, there is growing neurophysiological evidence to support the idea of EF skills as a primary weakness associated with ASDs that may underlie development of other aspects of cognitive development (Chan et al., 2009; Hill & Bird, 2006; O'Hearn et al., 2008; Pellicano, 2010). Children with EF skills deficits share a common difficulty of disengaging from their present course of action or expectation (e.g., environment, behavior, activity) to consider potential future needs or outcomes (Achenbach & Rescorla, 2004; Chan et al., 2009; Geurts et al., 2009; Hill, 2004; Robinson et al., 2009). These children typically develop at a slower rate than anticipated toward maturation of EF skills, where the individual's ability to be cognizant of the future and less stimulus or rule bound in the present becomes the expectation (Pennington & Ozonoff, 1996).

EF skill development seems to follow a relatively sequential progression from childhood through adolescence and into adulthood (Hughes & Ensor, 2010; Jurado & Rosselli, 2007; O'Hearn et al., 2008; Pellicano, 2010; Romine & Reynolds, 2005; Russo et al., 2007), although considerable variability in presentation across development in neurotypical individuals has been noted (Meltzer, 2007). Many professionals believe the expression of EF skills corresponds to particular points of brain development including synaptic pruning (elimination of unused synaptic connections) and myelination (V. Anderson, Levin, & Jacobs, 2002; O'Hearn et al., 2008; Romine & Reynolds, 2005). Neuroimaging studies have in fact indicated significantly slower white matter development in children with ASDs than in their neurotypical peers as well as generally slower or less developed neural connectivity, and decreased frontal cortical activation (Assaf et al., 2010; Carper, Moses, Tigue, & Courchesne, 2002; Cody, Pelphrey, & Piven, 2002; DiMartino et al., 2009; Geschwind, 2009; Koshino et al., 2005; O'Hearn et al., 2008). As EF skills involve complex cognitive interactions through the prefrontal and frontal cortexes (Chan et al., 2009; Geschwind, 2009; Robbins, 2000; Velazquez et al., 2009), the developmental view of EF expansion is substantiated by imaging techniques indicating the frontal lobe region is the last area of the brain to develop and myelinate (Hill & Bird, 2006; O'Hearn et al., 2008). Thus, while weak EF skills had been widely considered secondary to a developmental or acquired disruption of the specific portions of the frontal lobes (Chan et al., 2009; Robinson et al., 2009; Stuss & Knight, 2002; Stuss et al., 2000), neuroimaging has demonstrated EF skill weaknesses can also occur in corresponding cerebral networks, such as subcortical structures (Monchi, Petrides, Strafella, Worsley, & Doyon, 2006) or the parietal areas (Assaf et al., 2010; Jurado & Rosselli, 2007; Velazquez et al., 2009).

Given the conceptualization of EF skills as the coordination of higher level cognitive processes, it stands to reason that individuals with more typical developmental profiles should demonstrate better EF skills overall. Research has in fact supported this supposition in children with ASDs, finding those with better neurobiological connectedness and less subsequent behavioral involvement exhibit better abilities to meet the demands of their environment. Conversely, children with decreased neurobiological connectedness and subsequently more severe levels of ASD-related behaviors were less likely to effectively participate in their environment (Assaf et al., 2010; McTiernan, Leader, Healy, & Mannion, 2011; Zingerevich & LaVesser, 2009). While developmental EF skill deficits have not been found to be causally related to ASDs, they are believed to be a primary neurobiological condition underlying the cognitive differences and contributing to the behavioral difficulties demonstrated by individuals with ASDs (Assaf et al., 2010; Chan et al., 2009; DiMartino et al., 2009; Geurts et al., 2009; Gilotty, Kenworthy, Sirian, Black, & Wagner, 2002; Hill & Bird, 2006; Kenworthy et al., 2009; Ozonoff & Strayer, 1997; Pellicano, 2010).

Although EF developmental research has some variability of results, many studies have noted growth periods to occur in bursts from birth to age two-years, from about age five- to eleven-years, and from about age 16 to 19 years depending on definition and task demands (V. Anderson, Notham, Hendy, & Wrenall, 2001; Hughes & Ensor, 2010; O'Hearn et al., 2008). Given this pattern of shifting integration and organization, EF skills may be best considered from a developmental framework (Romine & Reynolds, 2005; Russo et al., 2007). EF skill difficulties can be expressed differently depending on a number of dynamic variables (e.g., age, intellect), as well as the etiology (e.g., genetic disorder, head injury), psychobiological factors (e.g., cortisol levels, sleep quality), context, and individual's general developmental trajectory (V. Anderson et al., 2001; Burgess et al., 2006; Channon, Charmon, Heap, Crawford, & Rios, 2001; Diamond, 2002; Geurts et al., 2009; Hill, 2008; Ozonoff, 2001; Pellicano, 2010; Pellicano et al., 2006; Russo et al., 2007; Shu, Lung, Tien, & Chen, 2001; Zillmer, Spiers, & Culbertson, 2008). As is the case with the expression ASDs characteristics, not all EF skills subdomains are impacted in the same manner at all points in development (Griffith, Pennington, Wehner, & Rogers, 1999). Research has made only moderate gains in relating EF deficits to particular ASD presentations. Some researchers have proposed this could be partly due to unrelated cognitive issues or comorbidity with other disorders (DiMartino et al., 2009; Verte' et al., 2006). Studies have indeed indicated an individual's developmental level affects EF measures differently, with children at different ages making widely different gains on traditional laboratory EF tasks (Diamond, 2002). One example would be on card sorting tasks that have been found less informative for younger or lower functioning individuals due to the task demands being well beyond their capabilities. Employing measures outside of a developmental framework may yield spuriously high error rates (Russo et al., 2007).

At other times, there may be minimal association between process and behavior as executive dysfunction can result in a number of behaviors, and conversely, a specific behavioral issue can be the result of a number of process deficits; this variation in antecedent and outcome relationship tends to cloud research and clinical work alike (Burgess et al., 2006; Jurado & Rosselli, 2007; Pellicano et al., 2006). Accordingly, the variability and number of potential EF processes are similar in many ways to the potential spectrum variations among people with ASDs. In their study of high functioning children with an ASD, Channon and colleagues (2001) found that while the stated problem solving solutions were often technically correct, the responses differed qualitatively from neurotypical controls as the solutions tended to lack consideration of others' motivation or feelings. These children offered less accuracy in detection of inappropriate behavior and offered more unrelated or unconventional solutions, but were satisfied at a level similar to neurotypical controls.

Research comparing EF skills of individuals with ASDs and those of neurotypical individuals is challenging as individuals with ASDs typically do not demonstrate the concomitant profile of verbal and nonverbal development found in neurotypical individuals, thus the discrepancies in performance between the two groups may be based on factors other than EF differences (Burack, Iarocci, Flanagan, & Bowler, 2004). Additionally, little progress has been made in using traditional EF measures to differentiate the various ASD subtypes, based on their EF presentation, (Pellicano et al., 2006; Szatmari, Tuff, Allen, Finlayson, & Bartolucci, 1990; Verte' et al., 2006). Verte' and colleagues (2006) believed the lack of clarity between the various ASDs is due to different or vague ideas regarding the shared and differentiating characteristics of the subtypes. They called for increased behavioral and neuropsychological precision to assist with both distinguishing ASDs from other disorders and between ASD subtypes. To conclude that EF skill deficits are a primary weakness for individuals with ASDs, EF deficits need to be tied back to the syndrome specific presentation of the individual (Liss et al., 2001; Pellicano et al., 2006; Verte' et al., 2006). To strengthen the relationship between EF deficits and syndrome specific presentation, information regarding levels of functioning should be derived from multiple sources (Pellicano et al., 2006).

While the importance of EF skills to general adaptive functioning is a widely agreed upon concept (Channon et al., 2001; Greene et al., 2008; Jurado & Rosselli, 2007; Zingerevich & LaVesser, 2009), a generally accepted formal EF definition continues to elude the field (Baltruschat et al., 2011; Kenworthy et al., 2009). The inconsistency of EF presentation, as well as contradictory research results in behavioral and biological domains, has led to a relatively high degree of variance within the labels or definitions given to specific EF skills (Greene et al., 2008; Hill, 2004; Jurado & Rosselli, 2007; Kenworthy et al., 2009; Zingerevich & LaVesser, 2009). Thus, for ease of discussion, EF skills are further reviewed as frequently grouped or discussed in the literature; however, the attentive reader will note a degree of overlap or interaction between the skill definitions and/or expressions as empirical separation of skills has been difficult (O'Hearn et al., 2008).

Inhibition

Inhibition is the ability to stop prepotent (i.e., previously selected or employed, dominant) responses to a stimuli in favor of one more appropriate to the situation or task at hand (Chan et al., 2009; Fernandez-Duque, Baird, & Posner, 2000; Gioia, Isquith, Guy, & Kenworthy, 2000; Greene et al., 2008; O'Hearn et al., 2008), and may be a key component underlying the development of other EF skills (Ikeda, Okuzumi, Kokubun, & Haishi, 2011). While signs of inhibitory control have been noted in preschool aged children (Jones, Rothbart, & Posner, 2003), inhibition seems to show the greatest development between six- and eight years of age, with typical adult-level skills by about age 10-years and mastery by about age 12-years (Brocki & Bohlin, 2004; Passler, Isaac, & Hynd, 1985). Inhibitory control is a necessary component of many daily activities, with inhibitory difficulties having been linked to lacking aspects of attentional control; specifically, an individual’s inability to internally maintain both selective and sustained attention (V. Anderson et al., 2002; Greene et al., 2008; O'Hearn et al., 2008).

Inhibitory difficulties have been implicated as a primary deficit in individuals with a number of disorders, including ASDs (Bishop & Norsbury, 2005; Chan et al., 2009; Robinson et al., 2009; Russell & Jarrold, 1999; Schmitz et al., 2006). Common behaviors consistent with inhibitory difficulties include distractibility, impulsivity, overactivity, and the tendency to interrupt others (Fernandez-Duque et al., 2000; Gioia et al., 2000). One traditional test of inhibitory control is a color-word interference task, where an examinee is presented with the names of colors, printed in an incongruent color ink (Ikeda et al., 2011). Examinees are instructed to name the word or the text color while ignoring the incongruent information.

Variations of the traditional color-word interference task have been developed to widen the scope (e.g., to those who cannot read) of this type of task. Some examples include the chimeric animal task where a part of a hybrid animal picture (e.g., a duck head on a dog body) is ignored in favor of another (Adams & Jarrold, 2009) and the flanker task where a particular shape has to be chosen while other shapes are ignored (Christ, Holt, White, & Green, 2007). Other types of interference tasks have also been developed that may measure other aspects of inhibition, such as stop-signal tasks where the individual is tasked with stopping a response when a tone is presented (Williams, Ponesse, Schachar, Logan, & Tannock, 1999), the dog-pig task where the child responds to a picture representing one animal with the opposite response (Diamond, Kirkham, & Amso, 2002), the negative priming task where a previously correct responses becomes a distractor in a subsequent trial (Hill, 2004), and the windows task where the child receives a reward for purposefully giving an incorrect response by choosing a box the child knows does not contain the reward (Russell, Hala, & Hill, 2003).

***Inhibition and ASDs*.** ASD related inhibition research results have been mixed (Adams & Jarrold, 2009; Ames & Jarrold, 2007), suggesting that in some cases, individuals with ASDs do not differ significantly from their neurotypical peers (Russo et al., 2007; Velazquez et al., 2009). Several studies have found no significant differences in the ability to inhibit over-learned responses between individuals with ASDs and their typically developing peers using traditional color-word interference tasks (Goldberg et al., 2005; Lopez et al., 2005; Semrud-Clikeman, Walkowiak, Wilkinson, & Butcher, 2010). Individuals with ASDs have also been found to have commensurate abilities to inhibit motor responses on a stop-signal task. While their responses were found to decrease in speed and accuracy when a negative priming aspect was introduced (a previously presented distractor was now the target), it was no more impacted than for their typically developing peers (Ozonoff & Strayer, 1997).

Inhibition studies using the same basic tasks have also resulted in dissimilar results, indicating that small differences in task requirements or presentation can significantly impact outcomes (Russell et al., 2003). In one such instance, Adams and Jarrold (2009) recreated a desire inhibition task where the child's previously indicated favorite sweet item was incorporated as potential choice for the cartoon character in the task. They found that children with ASDs had similar difficulties to typically developing peers in inhibiting conflicting cues (i.e., their desire for the sweet item versus task instructions). The difference in this task and previous experiments using a similar paradigm surrounded when the sweet item was introduced, which allowed for differentiation of inhibitory versus other contributory factors.

In other aspects of inhibition, children with ASDs demonstrate clear differences from neurotypical peers. Difficulty inhibiting prepotent responses has been noted on traditional windows tasks as well as on multistep windows tasks (detour-reaching), when there was significant reward for inhibiting prepotent responses. These findings held for control groups with similar intellect and control groups with similar developmental levels. The authors suggest this outcome is due to the participants having increased difficulty inhibiting proponent responses in an arbitrary situation (Hughes & Russell, 1993; Russell et al., 2003). On computerized tests of sustained attention, higher functioning children with ASDs were found to evidence developmentally appropriate sustained attention, but deficits in response inhibition, especially for randomly presented prompts (Johnson et al., 2007). The authors argued that this difference in response inhibition may be related to the lack of external cueing provided in the random trial over the fixed trial.

Planning

Planning is a complex, dynamic cognitive ability to set goals, develop an appropriate plan of action, or act in a systematic manner, while continuously monitoring, revaluating, and revising choices/actions/options (Hill, 2004; Jurado & Rosselli, 2007; Robinson et al., 2009). Some indications of verbal planning have been noted in typically developing children by age three-years (Hudson, Shapiro, & Sosa, 1995), with the development of strategic planning noted between ages seven- and 11-years (Levin, Culhane, Hartmann, Evankovich, & Mattson, 1991), and attainment of a typical adult-level planning skill set between ages nine- and 13-years (P. Anderson, Anderson, & Lajoie, 1996). A meta-analysis of planning skills studies found the greatest period of development tends to occur between ages five- and eight years (Romine & Reynolds, 2005).

Manifestations of planning difficulties can include poor sequencing, difficulty organizing oral and/or written expression, and poor organization and subsequent recall of newly learned material, among others (Gioia et al., 2000). The complexity and dynamic nature of this EF skill requires the coordination of a current situation conceptualization, with the identification of plausible alternatives, prioritization of potential outcomes, and choice making from the identified alternatives. While a planning dysfunction can be supported with the implementation of external prompting (Meltzer, 2007), it is the internalization of planning skills that allows for environmental integration.

Common measurement strategies used in the assessment of planning and problems solving abilities include manual or electronic tower tasks (Corbett, Constantine, Hendren, Rocke, & Ozonoff, 2009; Robinson et al., 2009; Semrud-Clikeman et al., 2010). Tower tasks generally consist of moving physical or electronic disks/blocks/balls according to set of rules, from a prearranged sequence to some other sequence, in as few moves as possible, as quickly as possible. Tower tasks typically prove difficult for a number of individuals with a variety of disorders, including ASDs (Hill, 2004; Ozonoff & Jensen, 1999).

Planning and ASDs. Individuals with ASDs in all age groups have demonstrated planning difficulties (Hill, 2004; Ozonoff, South, & Miller, 2000; Semrud-Clikeman et al., 2010), however there is some variance in the results across studies (Goldberg et al., 2005). Some researchers suggest a potential confounding variable in planning task performance may be the intellectual abilities of study participants (Hill, 2004; Ozonoff et al., 2000), while others consider planning performance additionally related to age (Goldberg et al., 2005). To address potential confounding variables, researchers in one study replaced the traditional tower task with a computerized presentation and matched the individuals with ASDs (age $\bar{x}$ = 12.91-years) with a control group of similar age and verbal and nonverbal intellectual processes, as well as a younger group (age $\bar{x}$ = 8-years) of neurotypical peers, assumed to have mental ages commensurate with their chronological age. Potential impulsive response variation was controlled through the use of a yoke procedure where the response rate between groups was compared before testing to ensure results would be reflective of executive skills differences rather than confounding characteristics. Individuals with ASDs were found to evidence significantly more ineffective moves and fewer completions with the minimum number of moves than individuals in either comparison group, on tasks requiring more than three moves to complete. Additionally, those with higher nonverbal intelligence consistently demonstrated faster initiation times than those with less well developed nonverbal abilities, suggesting an additive factor with regard to planning difficulties may be present in those with ASDs (Hughes, Russel, & Robbins, 1994). Similar findings related to the number of responses were also reported from another computer based study of planning skills comparing individuals with ASDs (IQ $\bar{x}$ = 109.7; age $\bar{x}$ = 11.01-years), to age, sex, and intellectually matched peers (Landa & Goldberg, 2005).

In a multi-site study comparing performance of individuals with ASDs (IQ $\bar{x}$ = 106.3; age $\bar{x}$ = 15.7-years) to matched typically developing peers on a computerized measure of planning, participants in the ASDs group were found to have significantly fewer completions with the minimum number of moves and take significantly more time to consider their next move, than their typically developing peers. Interestingly, while the number of ineffective moves for some solutions was significant, the result was inconsistent across trials (Ozonoff et al., 2004). Given the large sample size afforded by the study's multi-site design, additional analyses were completed by dividing the participants into three comparable subgroups by age (<12-years; 12 to 19-years; >20-years) for an analysis of age affects, and two comparable subgroups by intellect (lower IQ group $\bar{x}$ =86.7; higher IQ group $\bar{x}$ =111) for an analysis of intellectual impact. Ozonoff and colleagues found that intellectual subgroups demonstrated the same pattern of differences from their respective typically developing subgroup as found in the original analysis, indicating intellect was not the factor implicated in the performance differences. Analysis of interaction effects by age indicated that the youngest typically developing subgroup performed well below the mid and upper level subgroups, as did all the subgroups with ASDs. Thus, the authors conclude that while planning efficiency improves with age in typically developing individuals, it does not for individuals with ASDs (Ozonoff et al., 2004).

Not all planning studies have found large differences in planning skills. Semrud-Clikeman and colleagues (2010) found statistically significant differences in the performance of children with ASDs (IQ $\bar{x}$ = 100.8; age $\bar{x}$ = 10.6-years) on a traditional tower task, in comparison to children with similar intellectual abilities, although the overall effect size was small. When comparing samples of typically developing to children (IQ $\bar{x}$ = 109.9; age $\bar{x}$ = 12.5-years) to samples of matched peers with Asperger's disorder or High-Functioning Autism on a computerized task, Ozonoff and colleagues (2000) found no significant differences between groups on a computerized measure of planning. Finally, planning deficits also have been noted in the performance of individuals with ASDs on other tests considered to measure planning deficits, including excessive completion time and error rates in completing mazes (Prior & Hoffman, 1990) and specific motor tasks requiring a planned sequence of movements to retrieve an object (Hughes, 1996). The findings reviewed here would appear to suggest both the type task and the presentation method may be issues requiring consideration when attempting to link test performance to daily difficulties for individuals with ASDs (Happe', Booth, Charlton, & Hughes, 2006; Johnson et al., 2007; Ozonoff, 1995; Robinson et al., 2009).

Cognitive Flexibility

Cognitive flexibility is the ability to shift “set” or to change a thought or action based on the changing needs/requirements of a given situation (V. Anderson et al., 2002; Geurts et al., 2009; Jurado & Rosselli, 2007). Cognitive flexibility can be expressed in an individual’s ability to accept changes in routine, rules, or categorizations (Russo et al., 2007). Basic cognitive flexibility skills have been observed in children between ages three- to five-years (Espy, 1997), with significant increases noted between ages seven- to nine-years (V. Anderson et al., 2002), and maturation by adolescence (Jurado & Rosselli, 2007). Difficulties with cognitive flexibility are common among a variety of congenital and acquired (e.g., frontal lobe injury) neurological conditions (Russo et al., 2007; Stuss et al., 2000).

Cognitive inflexibility, one of the most concerning difficulties related to ASDs for parents, has been measured directly through card sorting, language switching, and activity switching tasks and indirectly through a variety of general, adaptive, and syndrome specific behavioral rating scales. Some authors mentioned that tasks designed to assess inhibition or planning also appear to measure characteristics of cognitive flexibility (Geurts et al., 2009; Russo et al., 2007). Cognitive inflexibility on sorting tasks has been traditionally surmised when an individual cannot correctly “shift” between potential sorting strategies (i.e., perseverates on one strategy), ignoring examiner prompts to the contrary (Robinson et al., 2009).

***Cognitive Flexibility and ASDs*.** Individuals with ASDs have been found to have difficulty in shifting sets in comparison to neurotypical control subjects (Ozonoff & Jensen, 1999; Ozonoff & McEvoy, 1994; Prior & Hoffman, 1990; Russo et al., 2007) as well as other neurodevelopmental (e.g., ADHD, language disorder) control groups (Geurts, Vertè, Oosterlaan, Roeyers, & Sergeant, 2004; Gioia, Isquith, Kenworthy, & Barton, 2002; Liss et al., 2001; Semrud-Clikeman et al., 2010), and psychiatric disorders (Szatmari et al., 1990), across time (Ozonoff & McEvoy, 1994) and culture (Shu et al., 2001). The tendency in the literature has been to consider card sorting perseverative errors as a central measure of cognitive flexibility, but some researchers point out that this may not be the best strategy for evaluating rigidity (Geurts et al., 2009; Liss et al., 2001). Individuals with acquired frontal lobe injuries have been noted to demonstrate significant numbers of perseverative and random errors (Stuss & Knight, 2002), while individuals with ASDs have been found to more consistently demonstrate deficits on the number of sorted categories in combination with the total number of errors (Hill, 2004). Differences in cognitive flexibility have also been noted with regard to verbal or general intellect of individuals with ASDs, such that controlling for verbal skills has consistently been shown to impact between group differences for number or percentage of preservative errors (Hill, 2004; Liss et al., 2001).

Some researchers believe the impact of verbal skills on performance may be a spurious result from statistical modeling practices, as others have found a positive relationship between poor flexibility and RRBIs (Lopez et al., 2005). However, research minimizing or eliminating verbal components has consistently resulted in improved performance in individuals with ASDs in comparison with matched control groups (Geurts et al., 2009). Language concerns have been addressed by the use of computers in measuring cognitive flexibility. Hughes and colleagues (1994) used a computer based measure to examine perseverative tendencies between controls and children with ASDs. They found the children with ASDs were the most different from age and developmental level control groups on the highest level tasks, suggesting increasing complexity lends itself to the individual being stuck in set, rather than simply evidencing difficulties with shifting set. Findings of performance differences, such as those based on presentation method, have resulted in a level of inconsistency between studies with regard to the degree of impairment or manifestation of the shifting difficulties demonstrated by individuals with ASDs (Geurts et al., 2009). In a comparison study between traditional and computerized card sorting tasks, Ozonoff (1995) found that electronic presentation of tasks was more easily received by individuals with ASDs than the traditional presentation methods.

When presented with a computer based flexibility task designed to be presented in stages, individuals with ASDs were found to evidence difficulty only at the end of the task. This finding suggests the perceived perseveration may be one of “stuck in set” rather than an inability to shift set as cognitive inflexibility is generally defined (Hughes et al., 1994). This finding would also appear to suggest that not only does the task type matter, but the presentation method may also be an issue for consideration when attempting to link test performance to daily difficulties (Cane, 2007; Geurts et al., 2009; Happe' et al., 2006; Ozonoff, 1995; Robinson et al., 2009). For example, Semrud-

Clikeman and colleagues (2010) suggest that lacking flexibility may be implicated in social functioning, especially as social relationships become more complex (i.e., fluid) in adolescence. While no study has linked difficulties on card sorting tasks to preservative tendencies in the daily lives of individuals with ASDs, the lack of functional implications certainly does not lessen the incidence of the problem (Hill, 2004). What is clear, is that cognitive flexibility is a multifaceted construct with functional implications for individuals with ASDs and related difficulties (Geurts et al., 2009; Semrud-Clikeman et al., 2010).

Generativity

Generativity is the capacity to spontaneously generate novel ideas and/or behaviors (Turner, 1997) and is assumed to be related to EF skills (Hill, 2004). Both semantic and phonemic fluency tasks are believed to measure generativity skills (Jurado & Rosselli, 2007). Semantic tasks require the individual to name words belonging to a particular category (e.g., fruits), while phonemic tasks require responses beginning with a particular letter (e.g., H). Improvements in fluency skills have been noted to occur at about age eight years and again at about age twelve-years (Brocki & Bohlin, 2004), with semantic fluency showing improvement before phonemic fluency (Jurado & Rosselli, 2007).

Generativity and ASDs. Individuals with ASDs have been found to have free recall deficits on some word fluency tasks in relation to neurotypical and matched controls (Minshew, Goldstein, Muenz, & Payton, 1992; Robbins, 2000; Robinson et al., 2009), but not on others (Minshew, Goldstein, & Siegel, 1995; Scott & Baron-Cohen, 1996). Interestingly, some evidence suggests that individuals with ASDs have significant difficulty generating unrelated words, but show no significant difficulty generating semantically related words (Boucher, 1988). A more comprehensive investigation of several types of fluency (e.g., verbal, ideational, design) was administered while controlling for age and intellect (Turner, 1999). Findings indicated difficulties in verbal, ideational, and design fluency were consistent across individuals with ASDs. Additionally, deficits in verbal and ideational fluency were found to be correlationally related to increased levels of repetitive behavior in the daily lives of the participants (Turner, 1999). Others have argued that lacking spontaneity of pretend play is also indicative of deficits in generativity, in that the children were unable to generate novel storylines and the behaviors to support them (Jarrold, Boucher, & Smith, 1996).

Working Memory

Working memory has been defined as both the ability to hold a verbal, visual, or spatial representation in immediate memory, while manipulating the representation (span), and the capacity of an individual to hold a number of representations in immediate awareness (Baddeley, 1992; Baltruschat et al., 2011; Russo et al., 2007). Working memory is commonly used in problem solving, understanding one's immediate environment, goal development, and goal attainment (Baddeley, 1998; O'Hearn et al., 2008) as well as in academic performance (Klingberg, 2010). Working memory underlies the organizational aspects of immediate memory in working toward goal attainment (Baltruschat et al., 2011; Ozonoff & Strayer, 2001). Development of working memory skills has been noted in children by age four years, with typical adult level skills developing by age eight years in some areas (e.g., fewer chunks), in adolescence for others (e.g., visual), and finally in early adulthood for integration (O'Hearn et al., 2008; Russo et al., 2007). Difficulties in working memory are common among a variety of congenital and acquired (e.g., stroke) neurological conditions (Klingberg, 2010).

***Working Memory and ASDs*.** Regardless of the definition employed, research has demonstrated some deficit in working memory for children with ASDs, although variance in the degree of impact throughout development has been noted (Baltruschat et al., 2011; Hoeksma, Kemner, Verbaten, & vanEngeland, 2004; Russo et al., 2007). A potential confounding factor is the significant difficulty developing tasks that isolate aspects of integrated EF skills like working memory, as working memory appears to contribute to performance of a variety of skills (Ozonoff & Strayer, 2001). For example, studies have shown increased evidence of perseverative errors and interference vulnerability in children with ASDs when completing self-ordered search tasks (Goldberg et al., 2005; Landa & Goldberg, 2005; Steele, Minshew, Luna, & Sweeney, 2007). The factors accounting for these difficulties are potentially multifaceted (e.g., working memory, flexibility, inhibition) and not easily differentiated.

In a study of verbal working memory, subjects were presented with two tasks, a sentence span task and a counting span task. Sentence span required participants to supply the missing word at the end of a simple sentence read by the examiner, then recall those missing words after the given set of sentences, which varied by trial. The counting span task involved a set of cards where the target dots of a specific color where interspersed in a field of dots of a different color. Participants were tasked with counting the target dots on each card in the set, then recalling the number of target dots on each card, in order. Individuals with ASDs performed significantly below that of the learning disabled comparison group with commensurate age and intellect. Interestingly, groups were not different in their abilities to recall a series of verbally presented numbers, or reverse a series of verbally presented numbers (Bennetto, Pennington, & Rogers, 1996).

In a study of spatial working memory in children, participants were required to complete an object retrieval procedure where they were tasked with recalling and avoiding previous choices in an effort to find a matching object. Children with ASDs were not found to demonstrate differences from the matched control group with developmental disabilities (Griffith et al., 1999). On a computerized set of tasks including object retrieval, order recall, and location recall, children with ASDs were also found to perform at a level consistent with matched and typically developing peers; however, performance was predicted by age and intellect within in all groups (Ozonoff & Strayer, 2001). One potential explanation for these results is the absence of sufficient memory load for testing the working memory capacity (Steele et al., 2007).

To address potential memory load issues, Morris and Colleagues (1999) used a computerized measure of visual location recall. Participants were required to remember varying levels of information, within and across trials. Results indicated that the group with an ASD had significantly more difficulty recalling information, in comparison to a matched control group of typical peers, as memory load increased. This finding held true both within trials and across trials when the participants were required to use previous information to complete the current task (Morris et al., 1999). Steele and colleagues also examined working memory load using an electronic task specifically designed to vary working memory load. The subjects for their study were required to demonstrate low average or above cognitive skills and were matched by intellect, age, and socioeconomic status. Individuals with ASDs were found to be impacted by memory load earlier than typically developing peers and to have more difficulty using information from the previous trial. The authors believed that this difficulty in using previous information indicates there is a planning component in working memory.

Self-monitoring

Self-monitoring is the ability to independently scrutinize, control, and modify one's personal thoughts and actions (Hill, 2004). Evidence of self-monitoring difficulties are many times the result of conjecture following observed patterns of performance deficits while examining other skills as measurement of these internal cognitive processes is difficult (Russell, 2002). Given that attempts at measuring self-monitoring are largely based on the reports of those experiencing a task, and that individuals with ASDs typically demonstrate difficulty with factors underlying effective communication and reflection, it stands to reason that measuring this process would be complex.

Self-monitoring and ASDs. Self-monitoring deficits in individuals with ASDs have been noted in error avoidance and correction (Russell & Jarrold, 1998), monitoring of intention (Phillips, Barron-Cohen, & Rutter, 1998), avoidance of intrusions (Chan et al., 2009), emotional control and behavior (Semrud-Clikeman et al., 2010), and memory tasks (Hill & Russell, 2002; Hughes, 1996; Russell & Jarrold, 1999). In contrast, informal tasks thought to specifically assess self-monitoring have not yielded significant differences in children with ASDs as compared to neurotypical or peers with learning disabilities (Hill & Russell, 2002).

Measurement of EF and ASDs

Traditional Approaches

Review of the general findings of EF research highlights the difficulties of attaining consistent results across studies (Allen, Robins, & Decker, 2008; Boucher, 1988; Jurado & Rosselli, 2007; Ozonoff & Jensen, 1999; Robinson et al., 2009). With the heterogeneity of individuals with ASDs, and without a formal definition of EF skills and no gold standard for measurement, assessment of EF and replication of findings has been untenable (Jurado & Rosselli, 2007). Ozonoff (2001) argued that the persistent inconsistency of ASD related research results is the rule rather than the exception. She considered the discrepancies in results to be related to the lacking clarity of specific deficits rather than vastly discrepant results. At times, tasks may be developed and believed to measure a specific aspect of functioning, but in reality the tasks lack clarity in what they sample (Gilotty et al., 2002; Hill, 2004; Robinson et al., 2009). Additionally, the inclusion of other conditions co-occurring with or appearing similar to ASDs further muddles the extent to which EF skills deficits can be determined to impact functioning specific to the ASD (Robinson et al., 2009; Volker & Lopata, 2008). Further, while a traditional test may be thought to reliably measure a given construct, current neuropsychological measures tend to simultaneously tap a number of underlying constructs (Bishop, Aamodt-Leeper, Creswell, McGurk, & Skuse, 2001; Hill, 2004; Jurado & Rosselli, 2007; Russo et al., 2007).

Often times traditional laboratory developed tests are too open-ended or ill-structured to be reflective of environmental utility, or they lack specificity with regard which EF skills are necessary for accurate performance (Hill & Bird, 2006; Miyake, Friedman, Emerson, Witzki, & Howerter, 2000; Verte' et al., 2006). The lack of correlation between traditional EF measures supports questions of construct and ecological validity (Geurts et al., 2009; Hughes & Ensor, 2010; Jurado & Rosselli, 2007). Additionally, traditional tests may also lack sufficient sensitivity to both (a) the complex and sophisticated interactions between EF skills and the environment, as real-life tasks many times lack structured cues, present in an open ended manner without a correct or incorrect response, and rely on an individual's previous experience; and (b) developmental EF issues in individuals with intrinsic conditions may be different than those identified in individuals with acquired disorders (Chan et al., 2009; Channon et al., 2001; Hill & Bird, 2006; O'Hearn et al., 2008).

Alternative Approaches

Jarado and Rosselli (2007) expressed concern regarding the construct validity of traditional EF measures. Burgess and colleagues (2006) advocated for a function led approach in addressing these issues, where the representativeness and generalizability of tasks are the focus (i.e., ecologically valid measures). Others have also argued for the measurement of EF in terms of an observable functional difference (i.e., an ecologically valid impact) rather than performance on a multifaceted measure (Gioia et al., 2000). In particular, it has been argued that the interaction of environmental demands and the individual's cognitive processes is the underlying factor resulting in functional EF related difficulties (Burgess et al., 2006; Gilotty et al., 2002; Jurado & Rosselli, 2007). Burgess and colleagues sought to add a degree of specificity to the EF concept in their model, suggesting that differentiation of EF skills should be made by defining the roles they play individual outcomes; these should then be used in research and clinical practice to facilitate consistency in definition and measurement. In effect, Burgess and colleagues, as well as Hill (2008) advocated for an interactional EF model based on functional impact rather than solely test performance, highlighting the fact that traditional laboratory tests do not generalize to behavior. To this end, Gioia and colleagues (2000) developed the Behavior Rating Inventory of Executive Function, a broad range questionnaire (i.e., indirect measure) for parents and teachers of children and adolescents, as well as a self-report measure for adolescents, to allow a clinician to examine functional EF skills across environments and situations.

The BRIEF has been used in a number of studies examining the EF skills of children with ASDs (see Figure 1). Overall, BRIEF results have indicated the most consistent difficulties with rigidity (shift), although most other scales are also elevated. The exception to this pattern is the subtest measuring the tendency to keep areas and materials in an orderly manner (organization). Chan and colleagues (2009) found BRIEF index scores to be significantly elevated for children with ASDs in general and in comparison to an intellectually matched control group. When comparing these results with neurophysiological imaging, the significant differences held true, thus the differences noted were considered an ASD-related effect and not related to intellectual differences. Studies have also found the Behavior Regulation Index (BRI) strongly correlated with the level of RRBI presentation in children with ASDs (Boyd, McBee, Holtzclaw, Baranek, & Bodfish, 2009; Kenworthy et al., 2009). Kenworthy and colleagues (2009), like other researchers (e.g., South et al., 2007; Turner, 1997), construed these behavior patterns as related to cognitive inflexibility. In their comparison of parent BRIEF ratings and parent ratings of sensory processing issues, Boyd and colleagues (2009) found no relationship between EF difficulties and sensory processing difficulties. Kenworthy and colleagues (2009) found that EF skills covaried with ASD symptoms and suggested that the heterogeneity of presentation between individuals is a feature for consideration in accounting for other potential factors impacting EF presentation. Gilotty and colleagues (2002) found the Metacognitive Index (MI) as well as the initiate and working memory subscales had the greatest association with adaptive behavior. Findings indicated that greater difficulties on the MI covaried with lower communication and socialization indicators. Additionally, poorer initiation and/or working memory were suggestive of lower communication and socialization skills overall. Zingerevich and LaVesser (2009) found higher ratings of EF skills using the MI and BRI were related to greater participation in many settings, including inclusive school activities, even when difficulties with sensory processing were considered. Overall, they deemed effective EF skills as being fundamental to inclusive school participation by students with ASDs.

Researchers are also beginning to question the presentation methods of various tasks and the impact a particular method may have on performance (Hill, 2004; Johnson et al., 2007; O'Hearn et al., 2008; Robinson et al., 2009). Some advocate for the development of EF instrumentation focused on clinical application rather based on a conceptual or experimental structure (Burgess et al., 2006). Consequently, a number of researchers now advocate for a more process oriented individual approach, where the heterogeneity of the syndrome is given due consideration, possibly creating subgroups or endophenotypes within ASD based on individual presentation (V. Anderson et al., 2002; Hill & Bird, 2006; Joseph & Tager-Flusberg, 2004; Lopez et al., 2005; Pellicano et al., 2006). Such a redirection would then refocus research to relate individual or subgroup presentation of a particular symptom set back to a particular EF profile, rather than asserting that a given diagnosis has a particular deficit (Goldberg et al., 2005). Such an approach could build on the work of Gioia and colleagues (2000) toward integrated and ecologically valid measures of EF skills.

This shift in conceptualization has been supported by research examining differences in EF presentation across developmental and acquired conditions (Goldberg et al., 2005; Luna, Doll, Hegedus, Minshew, & Sweeney, 2007; O'Hearn et al., 2008; Ozonoff & Jensen, 1999). Such an approach could eventually lead to certain EF profiles being indicators of particular conditions (Hill & Bird, 2006; Joseph & Tager-

Flusberg, 2004), the identification of markers related to developmental course, and allow for increased specificity in neurophysiological investigation (Goldberg et al., 2005; O'Hearn et al., 2008; Pellicano, 2007). Ultimately, a unitary model of EF skills deficits is inadequate to account for the level of heterogeneity present within ASDs (Joseph & Tager-Flusberg, 2004; Lopez et al., 2005; Pellicano, 2007); however, it may be possible to identify a specific cognitive endophenotype that parallels the behavioral phenotype.

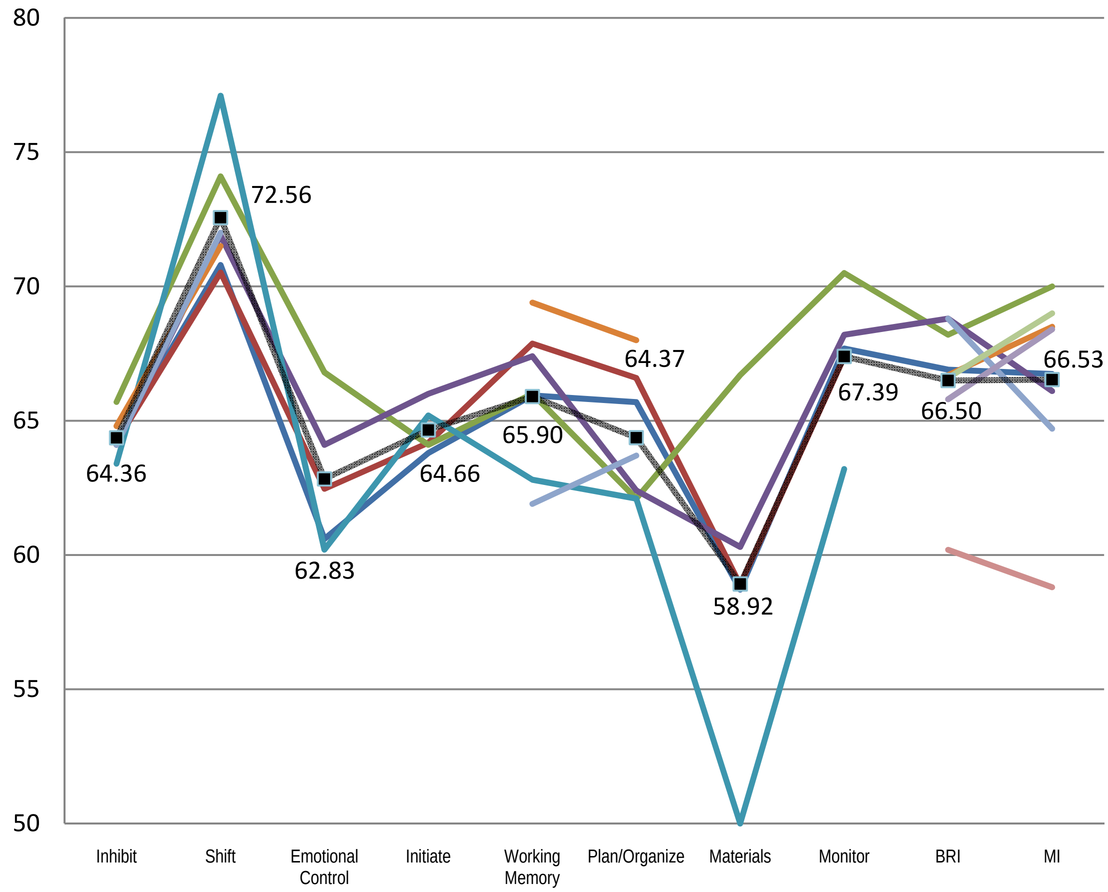

Figure 1. BRIEF Results Across Studies in T-scores.

Beyond the core features defining the syndrome, children ASDs can have wide-ranging emotional behavioral presentations. Thus, it stands to reason that an ecologically focused EF approach would consider the presentation of those behavioral characteristics defining the syndrome as well as the general presentation of behavioral characteristics of children with ASDs. A frequently employed method of evaluating ASD related characteristics and severity across circumstances and situations is through parent and teacher ratings using syndrome specific rating scales (Pandolfi, Magyar, & Dill, 2010; Sikora, Hall, Hartley, Gerrard-Morris, & Cagle, 2008). Use of a syndrome specific measure allows the clinician to benefit from observations of behavior not typically available in a clinical setting. A variety of such measures are available; however, they typically differ along several dimensions, including their underlying theory, intended uses, and the ASD related constructs they assess (Coonrod & Stone, 2005). Beyond standard psychometric issues, ensuring a chosen measure corresponds to diagnostic criteria as well as other well-established methods of identifying ASDs should be a primary concern in evaluating an instruments usefulness (Sikora et al., 2008). Stronger measures are those that reasonably differentiate ASDs from other disorders with varying degrees of similarity (Coonrod & Stone, 2005), although this task can be difficult given the level of heterogeneity in ASDs (Lord & Corsello, 2005).

A relatively new and seemingly well designed measure of this type is the Autism Spectrum Rating Scales (ASRS; Goldstein & Naglieri, 2009). The ASRS targets diagnostic characteristics of ASDs as defined in the diagnostic literature, as well as related issues (Naglieri & Chambers, 2009). To facilitate differentiation between ASDs and other disorders, the ASRS was normed based on a large and diverse sample including typically developing individuals as well as individuals with other neurodevelopmental conditions (Goldstein & Naglieri, 2009). Completed ratings result in a scale directly tied to diagnostic criteria, three factorially derived scales relating to the three core diagnostic areas of ASDs, a total summary score related to overall symptom level, and eights treatment scales to allow tracking of behavior over time. Results of studies completed prior to publication indicated that the ASRS differentiates well between ASDs and other conditions, as well as related well to other frequently use ASD-related rating scales. (Goldstein & Naglieri, 2009). Specific psychometric information is included in the instrumentation section of this study.

A method of considering the general behavioral presentation of individuals with ASDs is also through the use of parent and teacher ratings. Mahan and Matson (2011) point out that one broad based measure of behavior frequently incorporated in the evaluation of children with ASDs is the Behavior Assessment System for Children, Second Edition (BASC-2; Reynolds & Kamphaus, 2004). Volker and colleagues (2010) compared parent response means on the BASC-2 for a group (n=62) of children with high functioning ASDs and a group (n=62) of peers without a history of psychiatric diagnoses, developmental disabilities, or receiving special education services. Differences in parent response means resulted in effect sizes (i.e., Cohen's *d*) of more than two for children with ASDs on the atypicality, withdrawal, leadership, and functional communication scales. Effect sizes of at least one for children with ASDs were noted on the hyperactivity, depression, attention problems, adaptability, social skills, and activities of daily living scales. The differences for children with ASDs on the developmental social disorders content scale (DSDCS) resulted in an effect size above three, while differences in the executive functioning content scale (EFCS) resulted in an effect size of more than one. While the authors report that a score slightly above the average range (i.e., T=60) on the DSDCS provided the best differentiation between the two groups in their study, the wide developmental differences in their groups and the disqualification of all potentially confounding conditions in the comparison group does not suggest that this criterion would be useful as a general standard or that the dramatic differences noted in effect size would be maintained in daily practice.

In a similar study, Mahan and Matson (2011) compared parent responses on the BASC-2 for a group (n=38) of mostly male children with ASDs and a group (n=42) of mostly female peers without previous or current psychiatric diagnoses. The group with ASDs included children with numerous comorbid diagnoses and current psychotropic medication regimens. The means between groups were compared using 18 separate nonparametric analyses due to the non-normal distribution of the data. Analyses indicated significant differences between the groups on the hyperactivity, conduct problems, depression, somatization, atypicality, withdrawal, attention problems, adaptability, social skills, leadership, activities of daily living, and functional communication subscales. Neither the DSDCS nor EFCS scores were analyzed for differences. Overall, the results of this study suggested that boys with multiple emotional and behavioral conditions demonstrated significantly more difficulties modulating emotions and behavior than girls with no history of psychiatric issues (Mahan & Matson, 2011). However, similar to the Volker study, the usefulness of these results to clinical practice is extremely limited beyond the general conclusion of the existence of differences.

Statement of the Problem

EF skills deficits have been established as a common problem among neurodevelopmental and acquired neurological disorders, including ASDs. EF skills deficits themselves are not indicative or diagnostic of any given condition, but are evident across a number of conditions. The manner in which EF is impacted varies significantly between conditions, as well as between individuals with a particular condition, based on number of factors, including clinical presentation. Therefore, to develop a comprehensive understanding of EF functioning in conjunction with a given disorder, there needs to be an examination of EF skills by the syndrome under consideration (e.g., ASDs), as well as by the behavioral presentations (i.e., general and syndrome specific) of the individuals demonstrating the syndrome. Comparing an individual's behavioral presentation with only the criteria that define the syndrome, without also comparing it to others in the population, would ignore the various ways in which the syndrome maps onto EF skills (one aspect of the individual's neurocognitive phenotype). Such a course could not adequately consider the heterogeneity of the individuals with the syndrome or the developmental differences they demonstrate.

Although many recognize that individuals with ASDs often evidence functional EF skill difficulties (e.g., Ozonoff & Schetter, 2007), and some have asserted that EF skills deficits underlie other behavioral problems associated with ASDs (e.g., Lopez et al., 2005), research to this point has not successfully associated EF deficits and behavioral phenotypes in those with ASDs. Many researchers have hypothesized that this inconsistency is due to the fact that traditional laboratory measures of EF skills: (a) sample several skills simultaneously (e.g., Burgess et al., 2006), and (b) demonstrate poor predictive validity with regard to daily functioning (e.g., Kenworthy et al., 2009).

Beyond the lack of common EF skills profiles in individuals with ASDs, the extent to which specific EF skills (i.e., a neurocognitive phenotype component) are associated with both general behavior and the varying syndrome specific presentations (i.e., behavioral phenotype) evidenced by an individual with an ASD has not been studied. The purpose of this study is an initial attempt to address these gaps in the existing knowledge base with relation to how syndrome specific behaviors related to ASDs map onto both ecological EF skills as well as general behavior presentations.

Research Questions

Research Question #1

What is the relation between the syndrome specific behavioral presentation obtained using ratings on the ASRS (Goldstein & Naglieri, 2009) and the general behavioral presentation obtained using ratings on the BASC-2 (Reynolds & Kamphaus, 2004) for children with a previous diagnosis of an ASD?

It was hypothesized that a significant relationship between the two measures exists as the BASC-2 is designed to assess a number of conditions or emotional/behavioral characteristics that may be evidenced by a child with an ASD in their natural environments (home, school).

Research Question #1a. Are the subscales of the BASC-2 that were found to be elevated for students with ASDs in the standardization sample elevated for this sample of participants with ASD and were these the ones with the highest correlations?

It was hypothesized that this sample of participants would have a similar pattern of subtest score elevations.

Research Question #1b. Using the ASRS diagnostic scales and the derived Developmental Social Disorders content scale of the BASC-2, what is the level of association of the scores obtained?

It was hypothesized that while the correlation with the Developmental Social Disorders (DSD) content scale will be positive, the level of association will be low as the DSD scale is a derived scale covering a smaller range of symptomatology.

Research Question #1c. Using the ASRS clinical scales and the derived EF scale of the BASC-2, what is the level of association of the scores obtained?

Although EF skills deficits would be expected with children with ASDs, it was hypothesized that the correlation between the two scales will be relatively low (i.e., nonsignificant positive correlations are expected) due to the general nature of the EF scale, suggesting the need to examine associations between the ASRS and comprehensive EF skills measures.

Research Question #2

Are the subscales of the BASC-2 that were found to be elevated for students with ASDs as part of the standardization sample predictive of the scores on the ASRS?

It was hypothesized that the BASC-2 scale scores elevated for students with ASDs in the standardization study will predict elevations of the ASRS Scales scores for both the parent and teacher forms as both the elevations on the BASC-2 scales and the ASRS Scales are indicative of ASDs related behaviors and characteristics.

Research Question #3

What are the relations between behavioral characteristics of children with ASDs (behavioral phenotype) and their EF skills (EF phenotype)?

It was hypothesized that significant positive relations between the ASRS Scales scores and each of the scores of the executive skills measure will be found as the Scales scores are summary measures of ASDs related behaviors and characteristics that are associated with EF skill deficits.

Research Question #4

Do ASRS Scales scores predict elevations on the BRIEF (Gioia, Isquith, Guy, & Kenworthy, 2000) indexes?

It was hypothesized that scores on the ASRS Social Communication, Unusual Behavior, and Self-Regulation, scores will predict elevations on the BRIEF BRI and MI scores.

Research Implications

The concept of associating syndrome specific behavioral presentations as related to ASDs to both ecological EF skills and general behavioral patterns seeks to add clarity to an insufficiently defined neuropsychological construct, and to assist researchers, clinicians, and other interested parties in developing appropriate methods for identifying patterns and targets for improvements in behavioral performance. Identifying the EF deficits (i.e., profile of strengths and weaknesses within this cognitive domain) associated with specific patterns of ASD related behavior (behavioral phenotype) is critical for a number of reasons. Understanding the role of EF skills deficits in relation to behavioral phenotypes of children with ASDs may be helpful in clarifying specific EF constructs, adding to the discussion surrounding ecologically valid EF measures, and informing intervention planning at home, school, and in the community to improve academic, vocational, and social outcomes on an individual basis.

CHAPTER III

METHOD

Research Design

This study is a correlational within subjects design specifically targeting the relation between, and the patterns of behavior evidenced by, children with ASDs and EF skills deficits of the same children. It is cross-sectional in nature, rather than longitudinal; it utilizes a multi-source methodology in an effort to ensure that results are ecologically meaningful. The intent of this design was to allow correlation of individual scores, from varying sources, using syndrome and skill perspectives. To allow for adequate insulation against type II error using this approach, an overall sample size of 165 (Lenth, 2009) parent and teacher participants was sought; however, the final sample size fell well below this number. For parent participants, 59 completed the ASRS, 58 completed the BASC-2, and 34 completed the BRIEF. For teacher participants, 67 completed the ASRS, 64 completed the BASC-2, and 37 completed the BRIEF.

Participants

Participant data for this study came from multiple sources. Recruiting of parents through ASDs-related parent groups, schools, and clinics resulted in five parent packets being returned, and one corresponding teacher packet returned. Additionally, one teacher packet was returned without a corresponding parent packet. In order to increase sample size, a second IRB approved approach was used where parents were recruited through electronic means (e.g., list serves, newsletters). Electronic recruiting of parents resulted in two parent packets being returned and two corresponding teacher packets returned. Additionally, one teacher packet was returned without a parent corresponding parent packet. Finally, an existing data set of cases from a North Texas school district using the study measures was used. This data set included 33 parent and 34 teacher cases where all formal study measures were present. Additionally, 25 partial parent cases were gathered without the BRIEF, 1 partial parent case was gathered without the BASC-2, 30 partial teacher cases were gathered without the BRIEF, 3 partial teacher cases were gathered without the BASC-2. The total sample combining all methods is 126 cases, with a mean age of eight years, four months, and a standard deviation of one year, seven months. Demographic data by sampling method is provided in Table 1, educationally relevant information by sampling method is provided in Table 2, and study measures by sampling method is presented in Table 3. Of these, parent only data were available for 11 cases, teacher only data for 28 cases, and both for 34 cases. Chi-square comparisons of the samples by method of collection were not possible due to the low frequencies in 2 of the 3 data gathering methods.

Table 1
Demographic data by sampling method

	Data Gathering Method			
	Direct n=3	Electronic n=2	Database n=66	Total n=71
Mean Age	8 years 4 months	8 years 0 months	8 years 3 months	8 years 4 months
Gender				
Male	3	1	52	56
Female		1	14	15
Race/Ethnicity				
African decent			8	8
Asian decent			8	8
European decent	2	1	43	46
Hispanic decent			7	7
Native American decent	1			1
Region of United States				
Northeast	2			2
Southwest	1	2	66	69
Primary Communication Mode				
Verbal	3	2	66	71
Comorbid Diagnoses by Parent Report or Database Record				
ADHD		1	22	23
Anxiety Related Dx		1	7	8
Mood Disorder			1	1
Oppositionality			1	1
Learning Disability			5	5
Seizure Disorder			1	1
Auditory Impairment			1	1

Note. ADHD = Attention Deficit Hyperactivity Disorder; Dx. = Diagnosis.

Table 2
Educationally relevant information by sampling method

	Data Gathering Method			
	Direct	Electronic	Database	Total
Grade				
Kindergarten			8	8
First			7	7
Second	2		18	20
Third	1	2	14	17
Fourth			11	11
Fifth			8	8
Cognitive Functioning by Teacher Report or Database Record				
Above Average		1	9	10
Average	2		28	30
Below Average			10	10
Mod. Below Average		1	7	8
Sig. Below Average			11	11
Not Specified	1		1	2
Educational Services by Teacher Report or Database Record				
Speech Therapy	1	1	36	38
Educational Assistant			11	11
Behavior Intervention	1	2	13	16
Counseling	1		8	9
Occupational Therapy	1		23	24
Physical Therapy			1	1
Adaptive P.E.			2	2
In-home Training			3	3
Extended School Year	1			1
Special Transportation	1	1	2	4
Amplification System			2	2

Note. Mod. = Moderately; Sig. = Significantly; P.E. = Physical Education.

Table 3
Study measures by sampling method

	Data Gathering Method			
	Direct	Electronic	Database	Total
Parent Measures				
ASRS	3	2	54	59
BASC-2	3	2	53	58
BRIEF	3	2	29	34
Teacher Measures				
ASRS	1	2	64	67
BASC-2	1	2	61	64
BRIEF	1	2	34	37

Note. ASRS = Autism Spectrum Rating Scales (ASRS; Goldstein & Naglieri); BASC-2 = Behavior Assessment System for Children, Second Edition (BASC-2; Reynolds & Kamphaus 2004); BRIEF = Behavior Rating Inventory of Executive Function (BRIEF; Gioia, Isquith, Guy, & Kenworthy, 2000).

For the examiner-collected data, parents were recruited through various contacts and community organizations (e.g., parent support groups), schools, and clinics that serve children with ASDs as well as through electronic postings on list serves, bulletin boards, and email lists. Parents agreeing to participate in the study were also asked to recruit one of their child's teachers for participation. The remaining data was extracted from a de-identified data set maintained by a large urban school district in the southwestern region of the US. Regardless of the method, all raters were English reading parents and teachers (including therapists and interventionists) of children from six- to eleven-years old who had been previously diagnosed with Autistic Disorder, Asperger's Disorder or Pervasive Developmental Disorder, Not Otherwise Specified (PDD-NOS). There was no comprehensive verification of diagnosis, but all obtained scores on the ASRS DSM IV scale were above the average range ($\bar{x}$ = 70.36, sd = 6.76) suggesting that the children in this sample were demonstrating characteristics commonly associated with ASDs. No subtest or subscale scores of interest were missing from the dataset. When an entire protocol was absent, that case was excluded from the analyses when the information from the missing protocol was required for analysis. Similar criteria were used with the regard to consistency (i.e., validity scales) on the general behavior measure and the relevant EF scale(s). Those protocols deemed invalid based on guidelines provided in the manual were excluded. Using these criteria, two cases were eliminated from the examiner-collected data.

Measures

The measures utilized in this study included (a) a demographic information form for parents to complete (see Appendix A), (b) a demographic information form for teachers to complete (see Appendix B), (c) the Behavior Assessment System for Children, Second Edition (BASC-2; Reynolds & Kamphaus 2004), (d) the Autism Spectrum Rating Scales (ASRS; Goldstein & Naglieri), and 5) the Behavior Rating Inventory of Executive Function (BRIEF; Gioia, Isquith, Guy, & Kenworthy, 2000). For the sample taken from the database, the demographic information on parents and teachers was not available. These are each described in further detail.

Demographic Information Document for Parents (see Appendix A)

The demographic information form was used for descriptive purposes only, and only with the sample collected by this researcher. General demographic information requested included the child's age, grade, gender, race/ethnicity, preferred communication strategies, parent education levels and reduced/free lunch as indicators of family SES, information about siblings with ASDs, and city and state. Additional information requested included the child's age at initial diagnosis, behavioral and academic strengths and weaknesses, previous interventions attempted, and current interventions, (including medical or holistic regimens). Finally, instructions on how to receive the results of this study by email were included at the end of the form.

Demographic Information Document for Teachers (see Appendix B)

Again, only for the researcher-collected sample, teachers of children for whom parent consent was obtained was recruited to participate in the study, with preference for a teacher who has consistent contact with the child. Teacher information requested on the form included teaching area, years of teaching experience, teacher's age, gender, and race/ethnicity. Student information requested on the form included educational placement, type of educational services needed, strengths and weaknesses in the school environment, and general information about functioning level. Finally, instructions on how to receive the results of this study by email were included at the end of the form.

Behavior Assessment System for Children, Second Edition (BASC-2; Reynolds & Kamphaus, 2004)

The BASC-2 is a broad-band behavioral assessment measure for children to young adults (ages 2-21 years). This study utilized only the parent (160 items) and teacher (139 items) child rating forms designed to measure behavior demonstrated (during the previous 6 months) by children ages 6-0 to 11-11-years, using a paper/pencil four choice format (never to almost always). The BASC-2 is designed to be completed by someone with a 4^{th} grade reading level in about 20 minutes. The BASC-2 was designed to yield a comprehensive depiction of adaptive and clinical behaviors across environments and circumstances. Directly rated dimensions result in

T-scores, with between one and two standard deviations being termed “at-risk” and above two standard deviations being termed “clinically significant”. Dimensions include activities of daily living, adaptability, aggression, anxiety, attention problems, atypicality, conduct problems, depression, functional communication, hyperactivity, leadership, learning problems, social skills, somatization, study skills, and withdrawal. In addition to a variety of composite scales (externalizing problems, internalizing problems, inattention/hyperactivity, school problems, adaptive skills and behavioral symptoms index), responses to specific items can be used to yield several content scale scores including one for ASD-related behavior (Developmental Social Disorders) and another for EF skills (Executive Functioning). The BASC-2 manual reports high internal consistency for the assessed dimensions in the general sample (from .85 to .95) and in the clinical sample as well (from .89–.95). Reliability estimates for test–retest (from .76 to .92) and inter-rater reliabilities (from .70 to .88) also appear within acceptable limits for the assessed dimensions. In addition, concurrent validity was high with another well-established broad-band behavioral assessment measure (Matson et al., 2009).

During the standardization of the BASC-2, profiles of parent report (PRS) scores for children with ASDs (n=33) indicated clinically significant elevations were noted on measures of unusual behavior (atypicality), avoidance of others (withdrawal) and communication fluency (functional communication). At-risk elevations were noted on the summary score of major index scores (behavioral symptoms index), overactivity and impulsivity (hyperactivity), inattention (attention problems), acceptance of change (adaptability), effective interaction with others (social skills), the ability to work cooperatively with others (leadership), and functional independence (activities of daily living) (Reynolds & Kamphaus, 2004).

Profiles of teacher report (TRS) scores for children with ASDs (n=17) in the BASC-2 standardization sample indicated clinically significant elevations on scales of unusual behavior (atypicality) and avoidance of others (withdrawal). At-risk elevations were noted on the summary score of major index scores (behavioral symptoms index), acting in a hostile manner (aggression), acting unhappy or stressed (depression), acceptance of change (adaptability), effective interaction with others (social skills), the ability to work cooperatively with others (leadership), and communication fluency (functional communication) (Reynolds & Kamphaus, 2004). No studies were identified outside of the teacher standardization sample that used the BASC-2 as a primary diagnostic tool for children with ASDs or examined BASC-2 results for patterns of elevations related to ASDs presentation.

For this study, the scales of the PRS that were of interest include the Hyperactivity, Atypicality, Withdrawal, Attention Problems, Adaptability, Social Skills, Leadership, and Functional Communication scales. For this study, the scales of the TRS that were of interest include the Aggression, Depression, Atypicality, Withdrawal, Adaptability, Social Skills, Leadership, and Functional Communication scales. Internal consistency for parent responses in this sample was found to be .892. Internal consistency for teacher responses in this sample was found to be .862.

Autism Spectrum Rating Scales (ASRS; Goldstein & Naglieri, 2009)

The ASRS is a syndrome specific measure designed to be used in the assessment of ASDs in children and adolescents, ages 2 to 18 years (Goldstein & Naglieri, 2009). This study utilized the full-length forms (71 items) for parents and teachers of children 6 to 18 years of age. This ASRS is designed to be completed by someone with about a 6^{th} grade reading level and is estimated to take about 15 minutes to complete using the paper/pencil format. Resulting T-scores are presented in a summary score (total score), scale scores reflecting the three clusters of ASDs symptomatology (Social/Communication, Unusual Behaviors, Self-Regulation), a score reflecting the DSM-IV-TR diagnostic criteria, and a number of “treatment scales” related to specific areas for clinical attention (Goldstein & Naglieri, 2009). The ASRS manual reports high internal consistency for the full-length parent (from .92 to .96) and teacher (from .93 to .96) forms for children 6 to 18 years of age for the ASRS scales and the DSM-IV-TR scale. Reliability estimates for test–retest on the parent (from .92 to .95) and teacher (from .84 to .88) as also appear within acceptable limits for the ASRS scales and the DSM-IV-TR scale. Discriminant validity between children with ASDs and without ASDs was above .90 on average for both parent and teacher ratings across all scales. In addition, concurrent validity of parent and teacher ratings of the DSM-IV-TR (.80 to .83) scale as well as the Total scale (.81 to .82) was high with recently updated syndrome specific measures of ASDs (Goldstein & Naglieri, 2009).

As the ASRS is a new instrument, no studies beyond the studies using the standardization sample and reported in the manual. The ASRS manual reports the norming sample (6 to 18 years) consisted of 480 males and 480 females for both the parent and teacher versions. Additionally, the clinical sample for parent ratings included a total of 499 children (6 to 18 years), with 214 having an identified ASD. The clinical sample for the teacher ratings scale included 560 children (6 to 18 years) with 234 having an identified ASD (Goldstein & Naglieri, 2009).

For this study, the scales of the ASRS that were of interest are the Social/Communication, Unusual Behavior, and Self-Regulation Scales. Internal consistency for parent responses in this sample was found to be .84. Internal consistency for teacher responses in this sample was found to be .88.

The Behavior Rating Inventory of Executive Function (BRIEF; Gioia, Isquith, Guy, & Kenworthy, 2000)

The Behavior Rating Inventory of Executive Function (BRIEF) is a multidimensional indirect performance measure designed to assess EF skills of children. This study utilized only the child rating forms for parents and teachers (86 items) designated for children 5 to 18 years of age. The instrument is designed to be completed by someone with a fifth-grade reading level, in about 10-15 minutes, using a three-point choice scale (Never, Sometimes, Often) to rate behavior from the past six months. The BRIEF was designed to provide a sensitive and ecologically valid measure of executive skills (Gioia et al., 2000). Ratings result in T-scores, with a score of 60-64 labeled at-risk and scores 65 or above labeled clinically significant. EF skills measured by the BRIEF include inhibition, cognitive flexibility (shift), emotional control, working memory, planning (plan/organize), organization of materials, and self-monitoring (monitoring). Based on these scales, the BRIEF also yields several composite scores representing item content. Skills represented in the composite scores include regulation of cognitive flexibility, emotions and inhibition (behavioral regulation), initiate, plan organize and problem solve (metacognition), and a global summary of EF skills (global executive composite). The BRIEF manual reports high internal consistency for parents and teachers in the normative (from .85 to .98) and clinical (from .88 to .98) samples. Reliability estimates for test-retest (from .76 to 92) and inter-rater reliabilities (.55 to .96) appear to be within acceptable limits.

For purposes of this study, the variables of interest were the Behavior Regulation and the Metacognition Indexes. Internal consistency for parent responses in this sample was found to be .95. Internal consistency for teacher responses in this sample was found to be .96.

Procedures

Institutional Review Board (IRB)

The information pertaining to this study, including copies of the conflict of interest statement, introductory letter, consent forms, demographic forms, and instrumentation were submitted with a standard application to the TAMU office of research compliance for consideration and approved. No compensation will be offered to the participants. To increase the subject pool through broader promotion of the study using electronic means (e.g., email), an addendum to the initial IRB submission packet was submitted and approved. As the number of willing participants, as well as completed packets did not meet initial expectations, a second exempt application to allow the use of de-identified data from school district databases was submitted and approved.

Research Packets

Following IRB approval, the introductory letters, consent forms, demographic forms, and the CEFS were copied and BASC-2, ASRS and BRIEF protocols were ordered. Once all documents were received, packets were assembled for distribution with business reply envelopes addressed to the principal investigator (PI) at TAMU. Parent and teacher packets included the appropriate introductory letter, a consent form, the appropriate demographic information form, and study protocols (CEFS, BASC-2, ASRS, BRIEF). Parent and teacher packets were pre-coded except for the consent forms and distributed together to the parent in a large Brown Kraft clasp envelope as one research packet. As the parent and teacher packets looked very similar, a half sheet of yellow cardstock was attached to each packet to allow participants to quickly differentiation the forms. Given the nature of the data and subsequent analyses, only one parent and one teacher per packet was able to participate in this study.

Recruitment for Direct Data Collection

Initially, parents were recruited through ASDs related parent groups, schools, and clinics by the PI or another individual on his behalf. The study was explained in general terms similar to those described on the information form in both face-to-face and electronic recruiting. Willing face-to-face participants were given a research packet after they had the opportunity to ask the PI any questions. Parents responding to electronic information were emailed the IRB approved information form for review. If after reviewing the form they were willing to participate, a research packet was then mailed to them. Parents were asked to complete their packet of information within two weeks and return it to the PI in the business reply envelope provided. Parents were also requested to ask one of their child’s teachers to participate in the study within those two weeks. When the parent asked a teacher, they were requested to give them the teacher packet. In total, 74 packets were distributed, with a total of 7 parent packets and 4 teacher packets returned.

When the packets of information were returned, consent forms were removed and stored in a separate location. Commercial research protocols were scored using the scoring software designed for the respective instrument. Demographic information was coded using the predetermined format for consistency. Once an ASRS form was scored, the resulting scores were examined to ensure they met the criterion for significance and inclusion in the study. After all instruments were scored, validity scales were also examined and those determined to be valid on lie scales/consistency scales were included in the respective analyses.

Results of all forms were entered into a research database by code only. No identifying information is stored with the protocols or included in the data base. No scale or index score being examined in this study was unable to be derived due to missing responses, therefore score substitution (i.e., score imputation) was unnecessary. If an entire study protocol was missing, then the ratings for that case will be excluded for analyses that used the missing protocol only. Demographic information (gender, ethnicity/race, and SES) of those excluded due to lack of significance, validity problems, or missing data were tabulated to determine if systematic bias resulted in the exclusions. For the two cases were excluded, there does not appear to be a pattern of systematic bias.

As initially proposed parents were sought through contact with parent groups, clinics, and schools. Several organizations serving of children with ASDs or their parents allowed the researcher to forward flyers to be handed out at meetings, or blurbs to be included in newsletters, with only one being receptive the researcher making direct presentations to their parent members or participants. The researcher attended a state autism conference in north central United States. After meeting with parents individually and describing the study, about 60 parents took research packets for completion. An autism consultant in a rural district the southwestern United States agreed to take study packets and make the presentation to district parents. A major school district in the southwestern United States with a large group of children with

ASDs declined to allow the researcher to recruit participants due to not wanting their teachers to take time to complete the protocols.

A private school in the western United States asked the researcher to pay 10 teachers a half-day's salary to complete the protocols and make the school's founder second author on any publication resulting from the study. When the researcher explained this was not possible, the school declined to participate. A university-based parent group leader and another large public school district asked the researcher to provide their parents remuneration at or above $20 each as a condition to present information to their parent groups. When the researcher explained this was not possible, they also declined to participate. Overall efforts to gain participants through direct contact with parent groups, clinics, and schools resulted in five parent and two teacher packets being returned. Three of the parent and both of teacher packets met study parameters and were used in the study. In one of the excluded parent packets the instruments were not completed to a degree to allow them to be scored. In the other excluded parent packet, the parent returned one parent instrument and 2 teacher instruments, which did not fit within the study parameters.

To increase participation, a second proposal to the IRB was approved allowing the researcher to recruit participants using electronic means. Parents were recruited through the electronic media of ASDs related parent groups, schools, and clinics. Willing groups were sent a blurb to put in an email blast, on a bulletin board, or in an electronic newsletter. Parents were asked to contact the researcher at an email address specifically opened to manage study related information or by phone. Parents contacting the researcher were given a brief description of the study and forwarded the parent information form for review. If they continued to express an interest after reviewing the form, a research packet was mailed to them.

Additionally, contacts were made with practitioners specializing in services to families with children with ASDs. Many of the practitioners reported they were willing to pass the information along to the families that they served who would fit in the study group. Two university-based autism clinics forwarded the blurb to their databases of current and past clients. Several state and regional school psychology organizations also forwarded the information on their list serves, asking members to pass the information along to families they worked with or contact the researcher directly if they would like to participate. A member of the staff in a state department of education in the far western United States, as well as several in regional education support centers in the southeastern United States, also agreed to send information out to parents, practitioners and school districts. Other organizations and groups did not respond to email requests, with one stating that they did not promote any type of research. Overall efforts to gain participants through electronic contact with parent groups, clinics, and schools resulted in two parent and three teacher packets being returned. Both parent and two of the teacher packets met study parameters and were included in the study. The excluded teacher packet was returned without a parent packet, which did not allow for the protocols to be scored.

Existing Database

The ASRS publisher was contacted and provided the names of school districts using the instrument. Several names in the southeastern United States were provided and the researcher attempted to contact each of them. Several did not respond and others reported they did not use the ASRS consistently or did not maintain a database.

One large school district of more than 50,000 students maintains an extensive database of deidentified data relating to their evaluations of children with ASDs, which included those instruments being used in the current study. Access to the database was requested and granted. This information was then included in an exempt IRB request that was subsequently approved. Data available to the researcher included the appropriate scores necessary to complete this study, as well as basic demographic information (e.g., age, grade, ethnicity) and some general information related to functionality and placement. Data meeting the study guidelines were recovered and analyzed in the course of this study.

CHAPTER IV

RESULTS

Data Set

With the data set complete, descriptive statistics for each of the variables under consideration were generated to summarize the data and allow for consideration of shape and dispersion (i.e., skewness and kurtosis). Due to the nature of the data, (i.e., a clinically skewed sample by definition) skewness was expected; however, skewness and kurtosis for both the parent and teacher samples fell within acceptable limits. With regard to parent related variables of interest, skewness ranged from -1.42 to .78 and kurtosis ranged from -.60 to 2.99. With regard to teacher related variables of interest, skewness ranged from -.46 to 1.133 and kurtosis ranged from -.813 to 7.346. The obtained results of the ASRS, BRIEF, and BASC-2 measures in T scores are provided in Table 4. Specific analyses by research question follow.

Table 4
Descriptive data on measures of interest

	Parent		Teacher	
	M (SD)	Range	M (SD)	Range
Autism Spectrum Rating Scales				
Social Communication	65.03 (7.13)	52-82	69.90 (9.25)	47-85
Unusual Behaviors	65.03 (5.67)	47-75	69.90 (8.84)	49-85
Self-Regulation	62.50 (6.77)	41-78	64.60 (7.70)	47-85
Behavior Assessment System for Children, Second Edition Clinical Scales				
Aggression	55.59 (10.44)	36-80	57.80 (12.80)	43-99
Anxiety	54.29 (13.59)	28-96	53.89 (14.95)	38-103
Atypicality	75.22 (16.63)	49-112	76.11 (13.70)	49-118
Attention Problems	64.48 (7.24)	47-78	62.11 (7.58)	40-74
Conduct Problems	53.10 (10.03)	37-78	54.59 (9.88)	41-95
Depression	61.76 (14.63)	39-110	61.27 (10.64)	45-90
Hyperactivity	65.00 (12.52)	39-89	60.72 (11.57)	47-86
Somatization	50.22 (12.37)	36-84	53.42 (11.83)	42-96
Withdrawal	70.93 (14.12)	44-103	73.75 (12.27)	50-98
Behavior Assessment System for Children, Second Edition Adaptive Scales				
Adaptability	35.72 (8.86)	21-55	36.48 (7.32)	20-60
Functional Comm.	33.16 (10.43)	10-57	35.69 (9.56)	16-60
Leadership	39.53 (7.49)	21-57	38.05 (5.64)	30-64
Social Skills	38.05 (9.37)	18-59	36.92 (7.20)	27-58
Adaptive Skills	33.83 (7.63)	14-50	35.69 (6.36)	24-59
Behavior Assessment System for Children, Second Edition Content Scales				
Dev. Social Disorders	72.60 (9.84)	56-98	70.11 (7.50)	54-85
Executive Functioning	65.53 (10.62)	43-89	64.34 (11.27)	42-89
Behavior Rating Inventory of Executive Function				
Behavior Reg. Index	66.74 (10.21)	51-87	68.70 (14.50)	44-104
Metacognition Index	68.50 (8.33)	51-81	68.41 (10.65)	47-91

Note. Comm. = Communication; Dev. = Developmental.

Research Question #1

What is the relation between the autism behavioral phenotype obtained using the ASRS and the general behavioral presentation obtained using the BASC-2 scales? It was hypothesized that a significant relationship between the two measures exists as general behavior measures are designed to assess a number of conditions or emotional/behavioral characteristics that may be evidenced by a child in their natural environments (home, school).

Research Question #1a

Are the subscales of the BASC-2 that were found to be elevated for students with ASDs in the in the BASC-2 manual elevated for this sample of participants with ASD and were these the ones with the highest correlations? It was hypothesized that this sample of participants should have a similar pattern of subtest score elevations.

To address the first part of this question, the elevations in the BASC-2 manual for both parent and teacher ratings were identified. Elevations in the manual for children with ASDs on the BASC-2 parent measure that were two standard deviations above the mean were the Atypicality and Withdrawal scales, with elevations one standard deviation above the mean for the Adaptability, Attention Problems, Functional Communication, Hyperactivity, Leadership, and Social Skills scales. Results from this sample of parent ratings (see Table 4) resulted in a similar pattern of elevations, including mean scores more than two standard deviations above the mean for the Atypicality (75.22) and Withdrawal (70.93) scales, with elevations more than one standard deviation above the mean for the Adaptability (35.72), Attention Problems (64.48), Functional Communication (33.16), Hyperactivity (65.00), Leadership (39.53), and Social Skills (38.05) scales. Additionally, an elevation more than one standard deviation above the mean that was not noted in the manual occurred on the Depression (61.76) scale for this sample of parent ratings.

Elevations in the manual for children with ASDs on the BASC-2 teacher measure that were two standard deviations above the mean were also the Atypicality and Withdrawal scales, with elevations one standard deviation above the mean for the Adaptability, Aggression, Depression, Functional Communication, Leadership, and Social Skills scales. Results from this sample of teacher ratings (see Table 4) resulted in a similar pattern of elevations, including scores more than two standard deviations above the mean for the Atypicality (76.11) and Withdrawal (73.75) scales, with elevations more than one standard deviation above the mean for the Adaptability (36.48), Depression (61.27), Functional Communication (35.69), Leadership (38.05), and Social Skills (36.92) scales. Additionally, unexpected elevations in this sample of teacher ratings occurred on the Attention Problems (62.11) and Hyperactivity (60.72) scales, while the expected elevation on the Aggression (57.80) scale was not evident in these results. Thus, while the pattern of elevations for BASC-2 parent and teacher ratings are largely as expected based on the manual, some differences were identified. The noted differences in elevation patterns in the current sample aligned parent and teacher ratings rather than maintaining the slightly different pattern noted in the manual.

To address the second part of this question, correlational analyses were completed for the BASC-2 scales with the ASRS scales using two-tailed Pearson Product Moment Correlations. Results for parent completed instruments are presented in Table 5, with results for teacher completed instruments presented in Table 6.

Table 5
Correlations between Parent ASRS Scales and BASC-2 scores

	Parent ASRS		
Parent BASC-2	Social Communication	Unusual Behaviors	Self-Regulation
Adaptability	.34**	.24	.45**
Aggression	.27	.08	.35**
Anxiety	-.20	.18	.17
Attention Problems	.44**	.16	.40**
Atypicality	.37**	.39**	.33
Conduct Problems	.28	.14	.41**
Depression	.24	.15	.36**
Functional Comm.	.50**	.25	.26
Hyperactivity	.26	.14	.60**
Leadership	.38**	.18	.14
Social Skills	.48**	-.02	.08
Somatization	-.12	.08	.11
Withdrawal	.33	.14	.04
Dev. Soc. Disorders	.37**	.26	.64**
Executive Functioning	.51**	.28	.29

Note. ASRS = Autism Spectrum Rating Scales (ASRS; Goldstein & Naglieri); BASC-2 = Behavior Assessment System for Children, Second Edition (BASC-2; Reynolds & Kamphaus 2004). Comm. = Communication; Dev. Soc = Developmental Social; Func. = Functioning.

**$p < .01$.

Table 6
Correlations between Teacher ASRS Scales and BASC-2 scores

	Teacher ASRS		
Teacher BASC-2	Social Communication	Unusual Behaviors	Self-Regulation
Adaptability	.08	.30	.18
Aggression	-.72	.26	.52**
Anxiety	-.22	.23	-.06
Attention Problems	.18	-.02	.54**
Atypicality	.21	.30	.19
Conduct Problems	-.12	.12	.46**
Depression	.04	.29	.32**
Functional Comm.	.33**	-.06	.16
Hyperactivity	-.12	.40**	.70**
Leadership	.42**	-.15	.02
Social Skills	.46**	-.14	.15
Somatization	-.10	.15	-.02
Withdrawal	.62**	.11	.15
Dev. Soc. Disorders	-.01	.46**	.70**
Executive Func.	.56**	.13	.36**

Note. ASRS = Autism Spectrum Rating Scales (ASRS; Goldstein & Naglieri); BASC-2 = Behavior Assessment System for Children, Second Edition (BASC-2; Reynolds & Kamphaus 2004). Comm. = Communication.
**$p < .01$.

Based on these results, the relationship between the ASRS Social Communication Scale and the BASC-2 subtest scores for parents (see Table 5) varied widely, from -.20 to .50, with six of 13 subscales reaching the $p < .01$ level of significance. Notably the highest correlations were not necessarily the subscales that had the highest correlations in the BASC-2 Manual. The Atypicality ($r = .37$), Adaptability ($r = .34$), Attention Problems ($r = .44$), Functional Communication ($r = .50$), Leadership ($r = .38$), and Social Skills ($r = .48$) scales all reached significance at the $p < .01$ level; however, the Withdrawal, Hyperactivity scales were not found to have a significant relationship ($p < .01$) with the parent's Social Communication Scale score. The relationship between the Social Communication Scale of the ASRS and the BASC-2 subtest scores for teachers (see Table 6) also varied widely, from -.22 to .62, with only four of 13 subscales reaching the $p < .01$ level of significance and a different pattern of elevations emerging. The Withdrawal ($r = .62$), Functional Communication ($r = .33$), Leadership ($r = .42$), and Social Skills ($r = .46$) scales all reached significance at the $p < .01$ level; however, the Atypicality, Aggression, Depression, and Adaptability scales were not found to have a significant relationship with the teacher's Social Communication Scale score.

The relationship between the ASRS Unusual Behaviors Scale and the BASC-2 subtest scores for parents varied from -.02 to .39, with only one of 13 subscales reaching the $p < .01$ level of significance. The Atypicality ($r = .39$) scale reached significance at the $p < .01$ level; however, the Withdrawal, Adaptability, Attention Problems, Functional Communication, Leadership, and Social Skills were not found to have a significant relationship with the parent's Unusual Behaviors Scale score. The relation between the ASRS Unusual Behaviors Scale and the BASC-2 subtest scores for teachers varied from -.14 to 40, also with only one of 13 subscales reaching the $p < .01$ level of significance. None of those scales with elevated teacher scores on in the BASC-2 manual, Withdrawal, Adaptability, Aggression, Depression, Adaptability, Functional Communication, Leadership, or Social Skills scales were found to have a significant relationship with the teacher's Social Communication Scale score; however, the Hyperactivity ($r = .40$) scale demonstrated a significant relationship ($p < .01$) with the teacher's Social Communication Scale score. Interestingly, while the teacher's Hyperactivity scale score was not elevated in the BASC-2 manual, it was noted to be elevated in this sample.

The relationship between the ASRS Self-Regulation Scale and the BASC-2 subtest scores for parents varied from .60 to .04 with six of 13 subscales reaching the $p < .01$ level of significance. The Adaptability ($r = .45$), Attention Problems ($r = .40$), and Hyperactivity ($r = .60$) scales reached significance at the $p < .01$ level; however, the Withdrawal, Atypicality, Functional Communication, Leadership, and Social Skills did not demonstrate a significant relationship ($p < .01$) with the parent's Social Communication Scale score. Three subscales not elevated in the BASC-2 manual parent's ratings, Aggression, Conduct Problems, and Depression, also demonstrated significant relationships ($p < .01$) with the parent's Self-Regulation score. Interestingly, the teacher's Depression subscale was also elevated above one standard deviation from the mean for teacher ratings in this sample, while the Aggression and Conduct Problems scales were not.

The relationship between the ASRS Self-Regulation Scale and the BASC-2 subtest scores for teachers varied from -.06 to .70 with five of 13 subscales reaching the $p < .01$ level of significance. The Aggression ($r = .52$) and Depression ($r = .32$) scales reached significance at the $p < .01$ level; however, the Withdrawal, Adaptability, Adaptability, Functional Communication, Leadership, and Social Skills scales were not found to have a significant relationship ($p < .01$) with the teacher's Social Communication Scale score. Three subscales not elevated in the BASC-2 manual Teacher's ratings Attention Problems ($r = .54$), Conduct Problems ($r = .46$), and

Hyperactivity (*r* = .60) also demonstrated significant relationships (*p* < .01) with the teacher's Self-Regulation score.

Considering the elevated BASC-2 subscales and level of association with ASRS subscales, the results indicate that, with respect to the two most elevated BASC-2 scores, Atypicality and Withdrawal, Atypicality is significantly and positively correlated with parent ratings on Social Communication (*r* = .37) and Unusual behaviors (*r* = .39), but not with any of the teacher ASRS ratings. For Withdrawal, no significant positive correlations were found with parent ratings on the ASRS Scales, but teacher ratings of Social Communication (*r* = 0.62) were significantly positively correlated.

Research Question #1b

Using the ASRS scales and the derived Developmental Social Disorders content scale of the BASC-2, what is the level of association of the scores obtained? It was hypothesized that while the correlation with the Developmental Social Disorders content scale would be positive, the level of association would be low.

The BASC-2 DSDCS scale was elevated in this sample across raters (see Table 4). Comparison of parent ASRS scales scores with the parent BASC-2 DSDCS (see Table 5) resulted in significant positive correlation coefficients (*p* < .01) for Social Communication (*r* = .37) and Self-Regulation (*r* = .64) Scales, but not for the Unusual Behaviors Scale (*r* = .28). In contrast, comparison of teacher ASRS scales scores with the teacher BASC-2 DSDCS (see Table 6) resulted in significant positive correlations coefficients (*p* < .01) with the Unusual Behaviors (*r* = .46), and Self-Regulation (*r* = .70), but not the Social Communication Scale (*r* = -.01).

It appears that the hypothesis of a positive, but low correlation between the BASC-2 DSDCS was partially correct, at least with regard to parents BASC-2 ratings and the Unusual Behaviors Scale. Not anticipated were the high correlations with the Social Communication and Self-Regulation Scales for parent ratings or the high correlations with the Unusual Behaviors and Self-Regulation Scales for teachers. Based on these results, the BASC-2 DSDCS appears to have the strongest and most consistent relationship to the ASRS Self-Regulation Scale for both parent and teacher raters, but inconsistent relationships with other ASRS diagnostic scales by rater.

Research Question #1c

Using the ASRS scales and the derived EF scale of the BASC-2, what is the level of association of the scores obtained? Although EF skills deficits were expected with children with ASDs, it was hypothesized that the correlation between the two scales would be relatively low given the nature of using a single summary score (i.e., nonsignificant positive correlations were expected), suggesting the need to more closely examine associations between the ASRS and broader, more comprehensive EF skills measures.

Based on the results of the correlational analyses, the BASC- 2 EFCS appears to vary in relationship to the ASRS by rater. Parent ratings (see Table 5) resulted in significant ($p < .01$) positive correlation coefficients for Social Communication ($r = .51$), but not for Unusual Behaviors ($r = .28$) or Self-Regulation ($r = .29$) Scales. Teacher ratings (see Table 6) resulted in significant ($p < .01$) positive correlation coefficients for Social Communication ($r = .56$) and Self-Regulation ($r = .36$), but not for the Unusual Behaviors ($r = .13$) Scale. Thus, the hypothesis of nonsignificant positive correlations was partially correct. The BASC- 2 EFCS had low, but positive correlations with the Unusual Behaviors Scale for both raters. Not expected was the consistent moderate correlation between the BASC- 2 EFCS and the Social Communications Scales or the moderate correlation between teacher ratings and the Self-Regulation Scale. The EF score was moderately elevated for this sample.

Research Question #2

Are the subscales of the BASC-2 that were found to be elevated as part of the standardization sample predictive of the scores on the ASRS? It was hypothesized that the BASC-2 scale scores elevated for students with ASDs in the standardization study would predict ASRS Scales scores for both the parent and teacher forms.

Given the predictive nature of the question, six hierarchical regression analyses were employed, three with the parent ASRS Scales scores as dependent variables (DVs), three with the teacher ASRS Scales scores as dependent variables (DVs). The independent variables (IVs) used in these analyses were the child's age, those BASC-2 clinical scales that were elevated in the respective parent or teacher ratings of children with ASDs as reported in the BASC-2 manual, and the Adaptive Skills Index as a summative indicator of the adaptive domain. As adaptive skills deficits are common across a range of conditions, but are not diagnostic in nature, the composite Adaptive Skills Index was used to both give a measure of adaptive impact as well as decrease the number of variables in relation to sample size. Age was entered as the first variable in all six hierarchical regressions; all other variables were entered simultaneously in the second step.

With regard to parent rating on the ASRS Scales, the BASC-2 clinical scales included atypicality, withdrawal, hyperactivity, and attention problems. With regard to teacher ratings, on the ASRS Scales, the BASC-2 clinical scales included aggression, depression, atypicality, and withdrawal.

For the regression with parent BASC-2 scores and parent ASRS Social Communication Scale (see Table 7), the multiple regression was significant [F (6, 51) = 7.76; p < .001]. In examining the scores that were included in the regression, the only variable that contributed significantly was the summative adaptive skills composite (p < .001). The adaptive skills composite accounted for 23% of the variance in the Social Communication Score. The BASC-2 clinical scales elevations in parent ratings of children with ASDs, as reported in the manual (atypicality, withdrawal, hyperactivity, and attention problems), were not predictive of difficulties with appropriate use of communication skills in social contexts (Social Communication), as measured parent rating on the ASRS, in this sample.

Table 7
Parent BASC-2 elevations as predictors of parent ASRS Social Communication score

	Social Communication							
	Model 1			Model 2				
Variable	*b*	*β*	sig	*b*	*β*	*t*	sig	95% CI
Constant	64.67			15.83		1.87	.07	[-1.14, 32.79]
Age	.08	.02	.89	.49	.11	.96	.34	[-.53, 1.50]
Adaptive Behavior Index				.59	.63	4.70	<.001	[.34, .84]
Attention Problems				.08	.10	.56	.58	[-.21, .37]
Atypicality				.01	.03	.19	.85	[-.10, .13]
Hyperactivity				-.01	.09	-.17	.87	[-.19, .16]
Withdrawal				.02	.06	.35	.72	[-.09, .05]
R^2	.00			.48				
F	.02			7.76***				
ΔR^2	.00			.48				
ΔF	.02			9.29***				

*** $p < .001$.

For the regression with parent BASC-2 scores and parent ASRS Unusual Behaviors Scale (see Table 8), the multiple regression was not significant [F (6, 51) = 1.85; p <11].

Table 8
Parent BASC-2 elevations as predictors of parent ASRS Unusual Behaviors score

	Unusual Behaviors							
	Model 1			Model 2				
Variable	*b*	*β*	sig	*b*	*β*	*t*	sig	95% CI
Constant	64.28			53.04		6.328	<.001	[36.22, 69.87]
Age	.13	.04	.77	-.11	-.03	-.22	.83	[-1.11, .89]
Adaptive Behavior Index				.13	.18	1.08	.29	[-.12, .38]
Attention Problems				-.08	-.12	-.59	.56	[-.37, .20]
Atypicality				.14	.40	2.39	.02	[.02, .25]
Hyperactivity				-.01	-.02	-.10	.92	[-.18, .16]
Withdrawal				.00	.00	.03	.98	[-.11, .12]
R^2	.00			.42				
F	.09			1.85				
ΔR^2	.00			.18				
ΔF	.9			2.20				

For the regression with parent BASC-2 scores and parent ASRS Self-Regulation Scale (see Table 9), the multiple regression was significant [F (6, 51) = 6.91; $p < .001$]. In examining the scores that were included in the regression, the variables that contributed significantly were the adaptive skills composite ($p < .01$) and the Hyperactivity scale ($p < .001$). The adaptive skills composite accounted for nine percent of the variance in Self-Regulation and the Hyperactivity scale accounted for 17% of the variance in Self-Regulation.

Table 9

Parent BASC-2 elevations as predictors of parent ASRS Self-Regulation score

	Self-Regulation							
	Model 1			Model 2				
Variable	*b*	*β*	sig	*b*	*β*	*t*	sig	95% CI
Constant	63.86			28.70		3.48	.001	[54.68, 73.04]
Age	-.17	-.04	.75	.42	.10	.86	.40	[-.57, 1.41]
Adaptive Behavior Index				.34	.38	2.80	.01	[.10, .59]
Attention Problems				-.17	-.21	-1.22	.23	[-.45, .11]
Atypicality				.00	.00	.01	.99	[-.11, .11]
Hyperactivity				.33	.62	3.91	<.001	[.16, .49]
Withdrawal				-.04	-.08	-.67	.51	[-.15, .08]
R^2	.04			.67				
F	.10			6.91***				
ΔR^2	.00			.45				
ΔF	.10			8.26***				

*** $p < .001$.

For the regression with teacher BASC-2 scores and teacher ASRS Social Communication Scale (see Table 10), the multiple regression was significant [F (6, 57) = 12.91; $p < .001$]. In examining the scores that were included in the regression, the variables that contributed significantly were adaptive skills composite ($p < .001$) and the Withdrawal scale ($p < .001$). The adaptive skills composite accounted for 13% of the variance in Social Communication and the Withdrawal scale accounted for 26% of the variance in Social Communication.

Table 10
Teacher BASC-2 elevations as predictors of teacher Social Communication score

	Social Communication							
	Model 1			Model 2				
Variable	*b*	*β*	sig	*b*	*β*	*t*	sig	95% CI
Constant	67.65			18.23		1.70	.09	[-3.19, 39.65]
Age	.32	.05	.67	.21	.04	.39	.67	[-.86, 1.28]
Adaptive Behavior Index				.58	.41	4.26	<.001	[.31, .85]
Aggression				-.12	-.17	-1.74	.08	[-.25, .02]
Atypicality				-.12	-.18	-1.70	.09	[-.25, .02]
Depression				-.07	-.08	-.80	.43	[-.23, .10]
Withdrawal				.44	.61	5.86	<.001	[.29, .59]
R^2	.00			.58				
F	.18			12.91***				
ΔR^2	.00			.57				
ΔF	.18			15.41***				

*** $p < .001$.

For the regression with teacher BASC-2 scores and the teacher ASRS Unusual Scale (see Table 11), the multiple regression was not significant [F (6, 57) = 2.40; $p < .04$]. In examining the scores that were included in the regression, no variable contributed significantly.

Table 11
Teacher BASC-2 elevations as predictors of teacher ASRS Unusual Behaviors score

	Unusual Behaviors							
	Model 1			Model 2				
Variable	*b*	*β*	sig	*b*	*β*	*t*	sig	95% CI
Constant	81.13			60.45		4.17	<.001	[69.25, 93.00]
Age	-1.35	-.23	.06	-.89	-.16	-1.23	.22	[-2.32, .56]
Adaptive				-.126	-.09	-.68	.50	[-.50, .24]
Behavior Index								
Aggression				.12	.17	1.29	.20	[-.07, .30]
Atypicality				.19	.30	2.10	.04	[.01, .38]
Depression				.12	.15	1.10	.28	[-.10, .35]
Withdrawal				-.05	-.08	-.53	.60	[-.26, .15]
R^2	.23			.45				
F	3.61			2.40				
ΔR^2	.06			.15				
ΔF	3.61			2.10				

For the regression with teacher BASC-2 scores and the teacher ASRS Self-Regulation Scale (see Table 12), the multiple regression was significant [F (6, 57) = 5.90; p < .001]. In examining the scores that were included in the regression, the only variable that contributed significantly was Aggression scale (p < .001). The Aggression scale accounted for 15% of the explained variance in Social Communication in this sample.

Table 12
Teacher BASC-2 elevations as predictors of teacher ASRS Self-Regulation score

	Self-Regulation							
	Model 1			Model 2				
Variable	*b*	*β*	sig	*b*	*β*	*t*	sig	95% CI
Constant	72.58			20.54		1.83	.07	[-1.93, 43.00]
Age	-.96	-.19	.14	-.01	.00	-.01	.99	[-1.13, 1.12]
Adaptive				.35	.29	2.45	.02	[.06, .63]
Behavior Index								
Aggression				.26	.44	3.74	<.001	[.12, .41]
Atypicality				.03	.54	.43	.67	[-.11, .41]
Depression				.15	.20	1.69	.10	[-.03, .32]
Withdrawal				-.07	-.10	-.83	.41	[-.22, .09]
R^2	.04			.38				
F	2.30			5.90***				
ΔR^2	.04			.35				
ΔF	2.30			6.42***				

** $p < .01$. *** $p < .001$.

Research Question #3

What are the relations between behavioral characteristics of children with ASDs (behavioral phenotype) and their EF skills (EF phenotype)? It was hypothesized that significant positive relations between the ASRS Scales scores and each of the scores of the executive skills measures would be found. To address this question, a correlational matrix was generated examining the level of correlation between the scales of the ASRS and the subscales and composites of the BRIEF. Results for parent completed instruments are presented in Table 13, with results for teacher completed instruments presented in Table 14.

Table 13

Correlations between parent ASRS Scales and parent BRIEF scores

	Parent ASRS		
Parent BRIEF	Social Communication	Unusual Behaviors	Self-Regulation
Behavioral Regulation Index (BRI)	.20	.40	.56**
Inhibit	.17	.24	.56**
Shift	.21	.50**	.25
Emotional Control	.10	.26	.46**
Metacognition Index (MI)	-.08	.34	.52**
Initiate	.13	.12	.19
Working Memory	-.14	.24	.50**
Plan/Organize	-.09	.37	.59**
Organization of Materials	-.11	.28	.20
Monitor	.00	.39	.59**

Note. ASRS = Autism Spectrum Rating Scales (ASRS; Goldstein & Naglieri); BRIEF = Behavior Rating Inventory of Executive Function (BRIEF; Gioia, Isquith, Guy, & Kenworthy, 2000).

**$p < .01$.

Table 14
Correlations between teacher ASRS Scales and teacher BRIEF scores

	Teacher ASRS		
Teacher BRIEF	Social Communication	Unusual Behaviors	Self-Regulation
Behavioral Regulation Index (BRI)	.04	.60**	.44**
Inhibit	-.04	.46**	.55**
Shift	.08	.76**	.36
Emotional Control	.08	.51**	.29
Metacognition Index (MI)	.40	.25	.65**
Initiate	.53**	.13	.41
Working Memory	.13	.13	.69**
Plan/Organize	.35	.23	.58**
Organization of Materials	.23	.10	.62**
Monitor	.31	.42**	.63**

Note. ASRS = Autism Spectrum Rating Scales (ASRS; Goldstein & Naglieri); BRIEF = Behavior Rating Inventory of Executive Function (BRIEF; Gioia, Isquith, Guy, & Kenworthy, 2000).

**$p < .01$.

Based on these results, the relationship between the ASRS Social Communication Scale and the BRIEF scores for parents (see Table 13) were not significant. The relationship between the ASRS Social Communication Scale of the and the BRIEF scores for teachers (see Table 14) varied with only the Initiate subscale ($r = .53$) reaching the $p < .01$ level of significance.

The relationship between the ASRS Unusual Behaviors Scale and the BRIEF scores for parents varied from .12 to .50, with only the Shift subscale ($r = .50$) reaching the $p < .01$ level of significance. The relationship between the ASRS Unusual Behaviors Scale and the BRIEF scores for teachers varied with four of the eight subscales and one of the indexes reaching the $p < .01$ level of significance. The BRI ($r = .60$) as well as the Inhibit ($r = .46$), Shift ($r = .76$), Emotional Control ($r = .51$), and Monitor ($r = .42$) subtests all reaching the $p < .01$ level of significance.

The relationship between the ASRS Self-Regulation Scale and the BRIEF scores for parents varied with five of the eight subscales and both of indexes reaching the $p < .01$ level of significance. The BRI ($r = .56$) and the MI ($r = .52$), as well as the Inhibit ($r = .56$), Emotional Control ($r = .46$), Working Memory ($r = .50$), Plan/Organize ($r = .59$), and Monitor ($r = .59$) subtests all reached the $p < .01$ level of significance in this sample. The relationship between the ASRS Self-Regulation Scale and the BRIEF scores for teachers varied with five of the eight subscales and both of indexes reaching the $p < .01$ level of significance. The BRI ($r = .55$) and the MI ($r = .65$), as well as the Inhibit ($r = .55$), Working Memory ($r = .69$), Plan/Organize ($r = .58$), Organization of Materials($r = .62$), and Monitor ($r = .63$) subtests all reached the $p < .01$ level of significance in this sample.

Overall, the hypothesized relationship between the ASRS and the BRIEF as being positive seems to be somewhat true for the children in this sample. Parent and teacher ratings for both Self-Regulation and Unusual Behaviors were consistently positively related to BRIEF outcomes. While teacher ratings of Social Communication were also positively related, parent ratings indicated a number of negative relationships within the MI domain.

Research Question #4

Do ASRS Scale scores predict elevations on the BRIEF indexes? It was hypothesized that scores on the ASRS Social Communication, Unusual Behavior, and Self-Regulation, scores would predict elevations on the BRIEF BRI and MI scores. Given the predictive nature of the question, four multiple regression analyses were employed, two with the parent BRIEF BRI and MI scores (DVs), and two with the teacher BRIEF BRI and MI scores (DVs). The independent variables (IVs) used in these analyses were the child's age as well ASRS Social Communication, Unusual Behavior, Self-Regulation Scales scores from parent and teacher parent or teacher ratings, respectively.

For the regression with parent ASRS scores and parent BRIEF BRI (see Table 15), the multiple regression was significant [F (4, 29) = 4.02; p < .01]. In examining the scores that were included in the regression, the only variable with a statistically significant contribution to the relationship was the Self-Regulation Scale (p < .01). The Self-Regulation Scale accounted for 17% of the explained variance in the BRI score.

Table 15
Parent ASRS Scales as predictors of parent BRI score

	Behavior Regulation Index							
	Model 1			Model 2				
Variable	*b*	*β*	sig	*b*	*β*	*t*	sig	95% CI
Constant	74.41			3.67		.154	.88	[-45.09, 52.43]
Age	-.90	-.15	.41	-.71	-.17	-.75	.46	[-2.63, 1.22]
Social Communication				.21	.14	.89	.38	[-.27, .68]
Unusual Behaviors				.23	.12	.70	.48	[-.43, .89]
Self-Regulation				.65	.47	2.77	.01	[.17, 1.13]
R^2	.02			.36				
F	.71			4.02**				
ΔR^2	.02			.34				
ΔF	.71			5.04**				

** $p < .01$.

For the regression with parent ASRS scores and parent BRIEF MI (see Table 16), the multiple regression was not significant for the purposes of this study [F (4, 29) = 3.136; $p < .03$].

Table 16

Parent ASRS Scales as predictors of parent MI score

	Metacognition Index							
	Model 1			Model 2				
Variable	*b*	*β*	sig	*b*	*β*	*t*	sig	95% CI
Constant	72.28			35.32		1.74	.09	[-6.12, 76.75]
Age	-.443	.09	.62	-.07	-.01	-.08	.93	[-1.70, 1.57]
Social Communication				-.19	-.15	-.95	.35	[-.59, .22]
Unusual Behaviors				.19	.12	.68	.50	[-.28, .75]
Self-Regulation				.54	.48	2.68	.01	[.13, 95]
R^2	.01			.30				
F	.26			3.13				
ΔR^2	.01			.30				
ΔF	.26			4.04				

For the regression with teacher ASRS scores and teacher BRIEF BRI (see Table 17), the multiple regression was significant [F (4, 32) = 7.27; $p < .01$]. In examining the scores that were included in the regression, the only variable with a statistically significant contribution to the relationship was the Unusual Behaviors Scale ($p < .01$). The Unusual Behaviors Scale accounted for 24% of the explained variance in the BRI score.

Table 17
Teacher ratings on ASRS Scales as predictors of teacher BRI score

	Behavior Regulation Index							
	Model 1			Model 2				
Variable	b	β	sig	b	β	t	sig	95% CI
Constant	50.37			-48.92		-1.85	.07	[-102.72, 4.91]
Age	2.15	.22	.07	2.35	.24	1.85	.07	[-.24, 4.94]
Social Communication				.07	.04	.33	.74	[-.38, .53]
Unusual Behaviors				.92	.53	3.84	<.001	[.43, 1.41]
Self-Regulation				.47	.25	1.71	.08	[-.06, .99]
R^2	.05			.48				
F	1.73			7.27***				
ΔR^2	.05			.43				
Δ *F*	1.73			8.73***				

*** $p < .001$.

For the regression with teacher ASRS scores and teacher BRIEF MI (see Table 18), the multiple regression was significant [F (4, 32) = 11.61; $p < .001$]. In examining the scores that were included in the regression, the variables with statistically significant contributions to the relationship were the Social Communication ($p < .01$) and Self-Regulation ($p < .001$) Scales. The Social Communication Scale accounted for 10% of the explained variance in the MI score and the Self-Regulation Scale accounted for 27% of the explained variance in the MI score.

Table 18
Teacher ratings on ASRS Scales as predictors of teacher MI score

	Metacognition Index							
	Model 1			Model 2				
Variable	b	β	sig	b	β	t	sig	95% CI
Constant	44.24			-78.41		-3.25	<.001	[-127.63, -29.20]
Age	2.73	.27	.11	2.80	.27	2.4	.02	[.43, 5.17]
Social Communication				.58	.33	2.83	<.001	[.164, 1.00]
Unusual Behaviors				.18	.10	.80	.43	[-.27, .62]
Self-Regulation				1.09	.56	4.03	<.001	[.61, 1.56]
R^2	.07			.59				
F	2.66			11.61***				
ΔR^2	.07			.52				
ΔF	2.66			13.64***				

*** $p < .001$.

CHAPTER V

DISCUSSION AND CONCLUSIONS

Heterogeneity of ASDs

ASDs reflect pervasive neurodevelopmental disruptions in individuals that are evident in early childhood and continue into adulthood. Although ASDs are defined around three primary areas, the heterogeneous nature of related characteristics and behaviors is complex. Because of this heterogeneity, examining the general behavioral presentation and EF deficits of individuals with ASDs would allow for greater understanding of associated emotional or behavioral issues in relation to ASD symptom presentation. Research to this point has not successfully associated EF deficits or more general behavioral or emotional concerns with the behavioral phenotypes of ASDs. The purpose of this study was to begin to identify the relation of ASD symptomatology with global behavior and EF skills as measured by parent or teacher ratings, rather than performance based measures.

General Behavior

Clinical Scales

Consistent with existing research (Reynolds & Kamphaus, 2004), Atypicality (odd behaviors) and Withdrawal (social avoidance) were the most elevated scores across raters. In contrast to existing research, Attention Problems (inattention), Hyperactivity (overactivity and impulsivity), Aggression (acting in a hostile manner), and Depression (acting unhappy or stressed) were also consistently elevated, but to a lesser degree. In relation to the diagnostic scales on the ASRS, the Attention, Aggression, Hyperactivity, and Depression scales were consistently and significantly associated with Self-Regulation across raters. In terms of behavioral predictions and results of the ASRS scales, the regression equations were significant in only particular cases. Externalizing behaviors as measured by parent ratings of Hyperactivity and teacher ratings of Aggression emerged as significant predictors of Self Regulation difficulties. Teacher ratings of the active avoidance of social contact (Withdrawal) also emerged as a significant predictor of difficulties with appropriate use of communication skills in social contexts (Social Communication) difficulties. Surprisingly, none of the ratings were predictive of the Unusual Behavior Scale. These results suggest that the BASC-2 clinical scales are targeting very different behaviors than those measured by the ASRS. Further, the clinical categories from the BASC-2 do not necessarily predict or reflect the symptom sets of the ASRS.

Adaptive Scales

Interestingly, the adaptive behavior composite was the most consistent predicator of difficulties related social communication across raters. As these scales largely relate to positive aspects of social interaction (e.g., communication, social skills, adaptability), they may represent better measures of ASD-related characteristics than the broader clinical scales, or be indicative of the extensive impact of poor social communication in meeting environmental expectations, or some combination of both.

Content Scales

Two BASC-2 content scales that are intended to provide information on the developmental social problems and EF deficits were also examined in relation to ASD symptomology. The DSDCS was strongly related to Self-Regulation difficulties in this sample, but did not reflect overall ASD-related characteristics or behaviors as measured by the ASRS. While difficulties with overactivity, inattention, impulsiveness, and argumentativeness (Self-Regulation) may covary with ASDs, they are not diagnostic themselves. Thus, the behaviors targeted by the BASC-2 DSDCS and the ASRS are seemingly similar only with regard to aspects of externalizing characteristics, rather than the key social and communication aspects of ASDs. Use of the DSDCS may be most valuable then in further identifying issues and intervention needs specific to self-regulation rather than in diagnosis.

The BASC-2 EFCS was moderately related to difficulties with Social Communication across raters, but not with other ASRS scales. This suggests that the behaviors targeted in the BASC-2 EFCS scale only overlap with aspects of EF utilized in social communication. Thus, although EF is generally believed to be involved in behavioral regulation, the EFCS may be most useful as a predictor of problem-solving within the social context. Unfortunately, the lack of independent research using the EFCS makes informed interpretation difficult.

Executive Function

The BRIEF has been used in a number of studies investigating ecological manifestations of EF skills in individuals with ASDs. Consistent with prior studies, composites of the BRIEF were elevated for this sample. A considerable number of moderate to strong associations with Self-Regulation difficulties were noted across raters. Similarly, for teacher ratings, many of the BRIEF scales were associated with the Unusual Behaviors scale of the ASRS. Only teacher ratings on the initiation scale were moderately related to the Social Communication scale. For the parent ratings, only the shift scale was moderately related to the Unusual Behaviors scale. Differences in raters may reflect the differing demands for EF by context. Predictors of EF difficulties also varied by ASRS scale. Self-Regulation on the ASRS was consistently predictive of cognitive problem solving and planning struggles across raters on the BRIEF. Neither Social Communication difficulties nor Unusual Behaviors were consistently predictive of EF dysfunction though regression with parent and teacher ratings differed. These differences may reflect differences in environment and expectations.

Limitations

The results of this study are subject to a number of limitations including a reliance on ratings alone, small sample size, the included age range of those with ASDs, the mixture of data gathering methods, and characteristics of the selected measures. Relying solely on rating scales results in data that are likely impacted by the raters' attributions. Consequently, while a given characteristic may be evident, if the resulting behavior is misattributed, then subsequent ratings may not be accurate. This factor could be partially implicated in the differences noted between raters across instruments. The small sample size increased the likelihood of a non-representative sample and type-2 error, as well as limited the number of variables that could be analyzed, the power of those analyses, and the generalizability of the conclusions drawn on those analyses. In some instances, additional predictors would have been identified as statistically significant using a less restrictive level of significance afforded by a larger sample size.

The age range of this sample is positioned during a developmental period when EF skills are believed to be changing at a relatively rapid pace, in a group of children already identified with developmental differences. The mixture of data gathering methods make this study very difficult to replicate and increase sampling bias as few parents chose to participate and the majority of the database cases were referred because of their inability to master the general curriculum. Therefore, the final sample is predominately comprised of a fixed group of individuals developing differently than the majority of their peers. Finally, little independent research is available for using the BASC-2 with ASDs and the diagnostic validity of the ASRS. How these factors may have impacted the data is unclear.

Clinical Implications

Improved understanding of general behavioral presentation may lead to more efficient screening as well as identify or clarify additional characteristics impacting the success of individuals with ASDs. Similarly, it is posited that clarifying the behavioral and cognitive issues associated with ASDs will inform immediate and long-term intervention planning for individuals with ASDs. The aim of this study was to identify the relation between ASD symptoms and global behavior, as well as executive function deficits. Using parent and teacher rating scales, it is clear from this study that the three ratings scales used in fact do measure differing aspects of behavior; they are not redundant. Further, results of the BASC-2 or the BRIEF should not be considered as a means of ruling out a diagnosis of ASD or as a means of screening for ASD. At the same time, and consistent with prior research, there are some scales of the BASC-2 and the BRIEF that may support the need for intervention in particular areas (i.e., adaptive behaviors, unusual behaviors, behavior regulation). Given the heterogeneity of those with ASDs, it is likely the use of the BASC-2 and the BRIEF to provide additional information may be appropriate.

Directions for Future Research

These results suggest continuing research related to ASDs and EF is necessary. Identification of neurocognitive subtypes represents one potential avenue to distinguish more homogenous subtypes. These results also shed some light on the usefulness of these three measures – the ASRS, the BASC-2, and the BRIEF – with individuals with ASDs. On a larger scale, it may be appropriate to determine the extent of association between these three measures in a normative sample (i.e., establish the normative mapping of the target behaviors of the BASC-2 and the BRIEF on the ASRS). Having once identified the normative mapping would allow for comparison with results with a sample of individuals with ASD.

Specific to ASDs, there is a need for further research of possible endophenotypes. Future studies should incorporate a larger sample made up of data from a variety of sources and methods, including both performance based and ratings, to examine the ways in which global behavioral difficulties and EF deficits map onto ASDs. This would be an improvement over the current study in that more variables could be examined, the level of significance could vary, and recruitment would not require individual participant contact by the researcher, only access to information gathered in the course of typical professional activities (e.g., by schools hospitals). Additionally, entering response information in the database directly from scoring software would allow for more in-depth examination of item based responses that may add clarity to results (e.g., DSDCS).

Within specific measures, it may be appropriate to examine differing variables. For example, instead of the clinical scales of the ASRS, it may be that the ASRS treatment scales are better predictors of specific EF difficulties or behavioral concerns. Additionally, consideration of what scales measure may be useful as certain behaviors may covary with particular conditions, but are not diagnostic. Differences by cognitive level, independent functioning level (e.g., toileting, communication), environment (e.g., school, home, community), rater type, and degree of particular characteristics (e.g., social impairment, RRBIs) are all also likely worthy of investigation given the variations in relationship noted between raters. With a large enough sample, using a multi-site framework, it would be feasible to look at possible cluster analysis and identify specific sub-groups within ASD, thus decreasing the heterogeneity.

Conclusions

Increasing numbers of individuals are being identified as having an ASD and the outcomes for these individuals are not always positive. As yet, the underlying nature (e.g., etiology, course) and contributory factors (e.g., developmental level, previous intervention) to these differences are not well defined (Pellicano, 2007). Specific cognitive or co-occurring behavioral or emotional concerns further complicate our understanding. This study was an initial attempt to clarify how general behavior and higher level cognitive skills relate to syndrome specific presentations of children with ASDs. At least based on the rating scales used, the type and severity of ASD symptomatology did not consistently predict behavior problems or EF deficits. Further, the presentation of behavior problems may vary depending on the sample. In contrast, the EF deficits were significant and consistent with the findings of prior studies. Additional research continues to be needed to clarify the relation between ASD symptomatology and EF.

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APPENDIX A

Please answer the following questions about you and your child (use the back if needed).

What is your city and state? ____________________ Is your child a girl or boy? ____________

Is your child eligible for: ☐ Food Stamps ☐ Free/Reduced Lunches ☐ Neither

How far did your child's mother go in school? ____________________

How far did your child's father go in school? ____________________

What is your child's age? __________ What grade is your child in? ____________

What is your child's race/ethnicity? ____________________

How old was your child when he/she was first diagnosis autism or a related condition? ________

Does your child have any other diagnosed conditions?
☐ No
☐ Yes – Please list on back

Does your child have siblings with autism or a related condition?
☐ No
☐ Yes – Please list age/gender(s)

How does your child communicate with others? ____________________

Please list your child's behavioral and academic strengths: ____________________

Please list your child's behavioral and academic weaknesses: ____________________

Please list current interventions used with your child due to autism or a related condition (including medicines or other remedies):

Please list past interventions used with your child: ____________________

Please write the name and school of the participating teacher ____________________

To receive a copy of the results of this study, please email your request to: AUstudy@tamu.edu

APPENDIX B

Please complete the following information about you and the student you are referencing

Teacher Information

<table>
<tr>
<td rowspan="3">Your Teaching Field

☐ General Education – Academic
☐ General Education - Elective
☐ Special Education – Inclusion
☐ Special Education – Resource
☐ Half General/Special Education</td>
<td>Your Age</td>
<td rowspan="3">Your Ethnicity/Race

☐ Caucasian/White
☐ African American/Black
☐ Hispanic/Chicano
☐ Asian
☐ Native American
☐ Other:</td>
</tr>
<tr>
<td>Years of Teaching Experience</td>
</tr>
<tr>
<td>Your Gender

☐ Male
☐ Female</td>
</tr>
</table>

Student Information

Student's Educational Placement	Student's Functioning Level
☐ no classes in general education ☐ 1-2 classes in general education ☐ 3-4 classes in general education ☐ 5-6 classes in general education ☐ 7 or more classes in general education	☐ Well below expectations for age ☐ Moderately below expectations for age ☐ Slightly below expectations for age ☐ Typical for age ☐ Above average for age

Please list the student's academic and behavioral strengths and weaknesses:	Student's required educational services
______________________________ ______________________________ ______________________________ ______________________________ ______________________________ ______________________________ ______________________________ ______________________________ ______________________________ ______________________________	☐ Speech Therapy ☐ Educational Assistant ☐ Behavior Intervention ☐ Counseling ☐ Occupation Therapy ☐ Physical Therapy ☐ Extended School Year ☐ In-home Training ☐ Adaptive P.E. ☐ Special Transportation ☐ Other Therapy/Service:

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APPENDIX C

ASRS Scores by Scale and Rater

ASRS Responses																	
Social Communication						Unusual Behavior						Self-Regulation					
Parent			Teacher			Parent			Teacher			Parent			Teacher		
70	68	52	62	66	61	59	61	61	72	73	60	62	62	64	77	64	71
60	82	76	81	58	79	75	68	65	56	69	79	78	71	68	73	61	67
61	82	62	78	68	75	60	73	59	76	59	75	60	67	46	64	58	66
65	74	60	67	73	73	65	72	57	62	80	81	66	65	41	67	67	63
71	66	57	63	75	80	65	62	64	77	60	55	68	60	48	66	58	62
68	53	74	79	81	70	72	71	73	69	77	79	63	66	72	56	60	81
64	60	62	81	83	63	60	58	68	68	77	85	53	56	68	64	62	77
74	68	61	59	78	69	63	67	72	68	55	82	60	60	69	55	58	53
59	73	63	82	84	80	69	66	63	75	69	55	59	62	59	58	67	56
75	68	62	64	50	75	72	68	65	59	66	65	62	61	60	47	70	67
66	67	75	79	65	75	63	47	61	82	56	66	64	47	69	69	52	68
66	57	61	75	60	79	70	70	65	60	81	68	65	62	61	53	71	66
56	55	70	65	59	80	69	68	56	75	85	77	68	62	62	61	85	69
57	63	61	60	68	78	66	73	70	49	77	81	66	77	61	59	81	72
70	68	63	85	75	79	66	73	57	77	77	78	60	65	68	71	66	75
73	54	66	83	74	76	60	68	71	54	73	76	56	50	64	69	66	73
66	62	81	53	61	72	55	60	67	61	69	66	70	61	64	61	65	66
63	66	52	64	71	65	72	63	66	70	61	73	65	58	64	59	68	53
61	63	70	59	67	63	59	64	73	69	55	75	63	62	64	67	58	60
67	62		55	47	59	63	64		73	57	69	58	68		63	53	60
			83	64	62				65	74	73				62	63	62
			64	75	64				78	73	69				57	60	
			62						76						69	82	

APPENDIX D

BRIEF Scores by Index and Rater

BRIEF Scores							
Behavioral Regulation				Metacognitive			
Parent		Teacher		Parent		Teacher	
75	60	67	75	68	75	74	76
87	64	66	49	80	75	76	70
51	70	59	64	71	70	69	86
58	64	73	77	55	70	74	80
52	58	78	69	51	75	62	81
64	51	82	64	71	54	65	71
62	52	51	64	66	56	50	71
62	80	55	67	77	80	63	56
62	63	89	63	66	64	60	59
67	84	48	104	76	75	76	61
70	55	44	76	64	52	71	65
67	64	48	87	75	59	71	67
69	61	63	78	66	74	77	79
79	79	73	79	76	71	77	82
58	78	50	69	73	68	60	47
66	76	98	74	72	59	91	66
87	74	47	59	81	64	48	50
		92	69			85	64
		67				78	

APPENDIX E

BASC-2 Parent Clinical Scales Scores

BASC-2 Parent Clinical Scores											
Hyperactivity			Atypicality			Withdrawal			Attention Problems		
80	69	72	91	110	57	71	85	58	77	69	69
86	47	76	90	110	99	56	103	80	70	77	72
75	65	39	55	81	65	73	78	65	70	69	51
77	64	39	65	76	54	83	75	62	78	67	51
77	53	39	98	60	54	80	63	71	76	67	59
67	60	87	99	74	112	74	68	74	72	62	74
94	61	69	99	65	78	97	80	53	98	64	69
63	61	43	73	62	57	89	85	65	61	59	56
45	58	72	70	84	97	98	90	80	61	64	64
78	43	58	73	60	49	83	65	51	72	56	56
69	61	84	81	78	60	89	65	75	67	64	73
49	58	64	65	73	60	49	60	63	53	61	67
72	89	72	107	97	75	76	74	51	67	67	67
73	58	71	76	75	79	56	87	58	62	59	59
71	45	72	76	65	57	66	76	80	62	53	72
68	62	78	57	63	89	78	83	44	62	56	67
76	66	72	70	60	99	71	100	85	69	67	67
69	68	74	70	74	60	67	51	44	56	62	69
47	72	65	73	83	75	49	51	76	59	69	53
55			49			58			47		

APPENDIX F

BASC-2 Parent Adaptive Scales Scores

BASC-2 Parent Adaptive Scores											
Adaptability			Social Skills			Leadership			Functional Communication		
30	23	44	29	31	39	38	34	53	28	10	50
32	28	41	43	18	52	34	21	38	32	10	18
30	25	50	23	35	46	36	40	44	27	21	43
23	39	53	30	46	46	27	45	55	27	44	52
37	42	35	41	46	42	47	31	42	14	32	43
55	37	21	31	30	37	36	38	40	33	32	16
67	37	25	3	31	31	8	31	34	7	18	28
39	39	44	39	29	35	38	36	42	35	21	47
25	30	30	22	43	48	34	31	42	38	23	26
44	41	42	33	33	32	34	36	52	32	37	49
41	39	28	33	50	30	38	44	29	43	33	33
51	48	32	43	50	48	41	44	57	39	37	35
35	21	37	39	52	54	36	49	49	28	42	33
30	39	32	32	42	50	36	29	47	28	16	30
32	55	37	28	50	39	36	29	40	21	42	37
32	30	32	30	34	25	34	45	38	35	37	33
39	25	30	52	28	27	42	36	27	45	37	28
39	32	28	52	41	31	51	41	49	45	33	57
35	44	21	59	31	44	46	46	46	37	33	40
32			41			43			47		

APPENDIX G

BASC-2 Teacher Clinical Scales Scores

BASC-2 Teacher Clinical Scores											
Aggression			Atypicality			Withdrawal			Depression		
61	67	63	79	75	56	92	52	74	85	64	61
99	50	46	49	79	85	50	52	66	56	45	66
52	46	46	72	98	85	57	87	68	53	58	63
43	48	65	66	79	89	55	66	82	58	62	55
52	61	50	82	53	63	68	52	60	53	48	48
70	67	67	85	79	72	90	81	79	55	53	74
52	61	65	82	59	95	71	60	72	50	58	79
50	48	65	72	72	69	55	72	57	50	70	53
43	46	65	59	66	56	63	66	72	55	63	50
85	83	50	82	79	69	79	82	78	58	79	62
43	43	67	98	59	92	98	79	95	61	48	73
57	59	69	72	72	82	74	84	86	63	55	73
43	79	65	79	89	56	74	95	72	50	62	50
55	92	52	95	95	66	61	82	87	47	90	48
50	46	84	56	79	85	71	84	86	55	71	64
46	52	74	76	98	101	68	79	92	48	79	69
57	48	69	79	118	75	72	76	72	67	53	79
50	54	61	62	82	79	78	63	84	53	77	77
45	43	57	82	53	76	92	71	84	64	53	55
57	54	65	75	85	63	83	74	57	59	69	58
46	43	54	72	79	76	55	87	76	71	74	53
54			59			71			69		

APPENDIX H

BASC-2 Teacher Adaptive Scales Scores

BASC-2 Teacher Adaptive Scores											
Adaptability			Social Skills			Leadership			Functional Communication		
31	47	39	33	58	33	37	64	42	26	60	46
36	45	35	40	43	38	43	51	32	46	34	31
37	41	35	42	33	38	37	35	32	27	21	32
31	38	37	54	42	38	39	40	30	41	36	18
35	35	31	40	33	31	35	42	32	31	32	36
33	36	33	29	42	33	32	40	42	19	40	39
37	41	36	38	43	42	39	49	40	56	36	40
37	36	29	29	39	29	32	33	35	39	37	23
41	37	30	42	33	32	37	35	36	39	24	41
21	23	34	33	31	32	42	37	36	36	42	43
45	60	26	29	45	32	37	37	38	39	26	27
35	35	20	42	27	28	47	35	31	52	16	33
47	36	30	29	28	32	32	36	36	27	30	41
47	23	35	32	27	40	33	32	39	30	21	34
52	37	32	34	38	40	35	37	36	29	34	44
48	33	41	40	29	31	35	37	32	24	39	29
38	37	32	49	33	37	43	35	45	41	29	34
40	39	29	30	42	38	40	42	39	41	24	44
26	52	37	28	38	49	31	44	39	31	46	49
32	43	37	28	38	42	31	39	44	30	41	46
35	45	37	58	42	42	39	39	42	37	59	44
37			43			42			42		

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